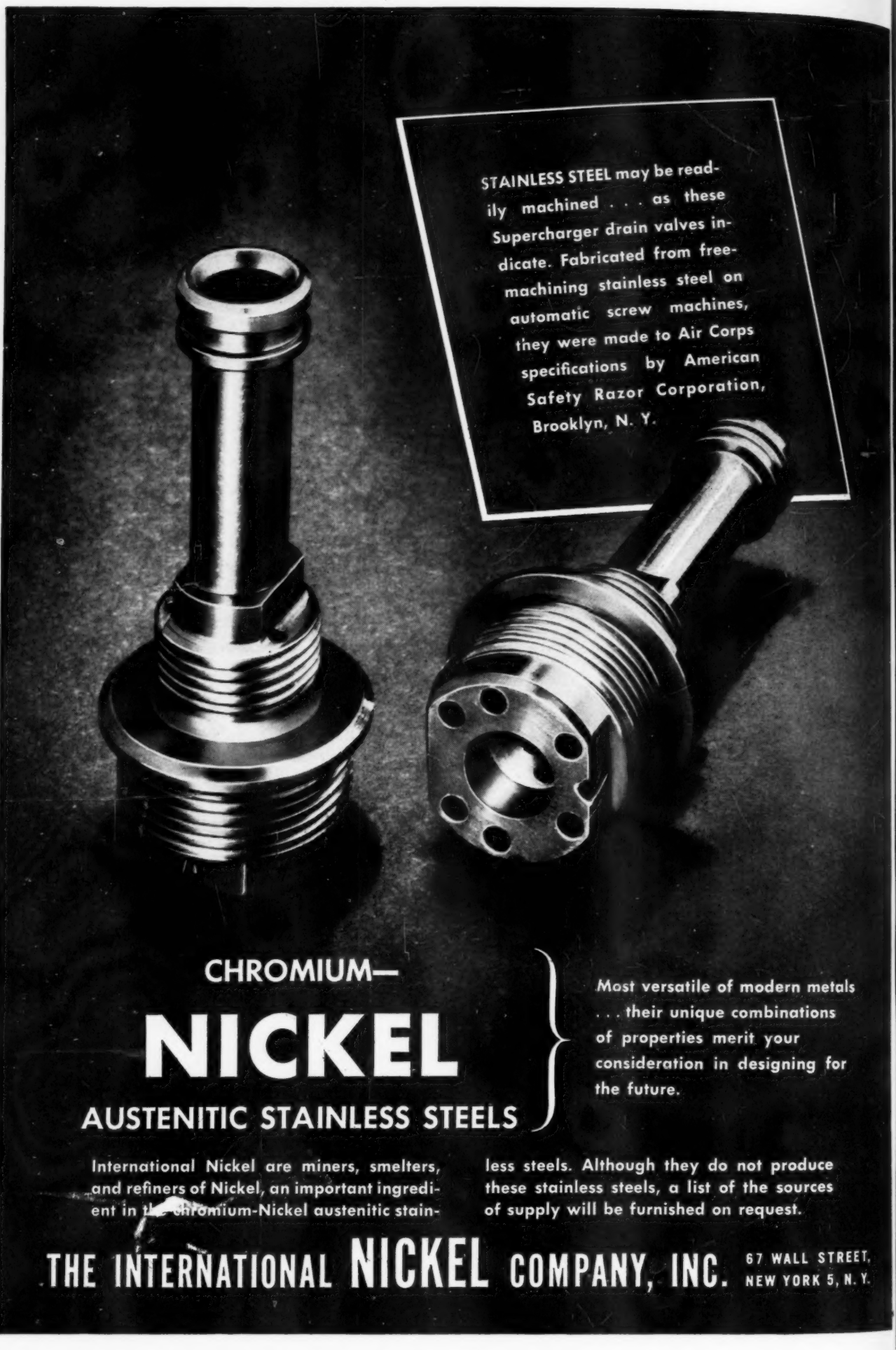
ARMY ORDNANCE

VOL. XXXI, No. 158 SEPTEMBER-OCTOBER, 1946

VICE ADMIRAL W. H. P. BLANDY, U.S.N.
Commander of Operation Crossroads

N THIS ISSUE

EVIEW OF INDUSTRIAL
AREDNESS FOR NATIONAL
ISE PUBLISHED BY THE
ORDNANCE ASSOCIA-
WASHINGTON, D. C.


STAINLESS STEEL may be readily machined . . . as these Supercharger drain valves indicate. Fabricated from free-machining stainless steel on automatic screw machines, they were made to Air Corps specifications by American Safety Razor Corporation, Brooklyn, N. Y.
CHROMIUM—
NICKEL
AUSTENITIC STAINLESS STEELS
Most versatile of modern metals . . . their unique combinations of properties merit your consideration in designing for the future.
International Nickel are miners, smelters, and refiners of Nickel, an important ingredient in the chromium-Nickel austenitic stainless steels. Although they do not produce these stainless steels, a list of the sources of supply will be furnished on request.
THE INTERNATIONAL NICKEL COMPANY, INC.
67 WALL STREET, NEW YORK 5, N. Y.

ARMY ORDNANCE was entered as second-class matter, August 14, 1920, at the Post Office at Washington, D. C., under the Act of March 3, 1879. Additional second-class entry at the Post Office at Richmond, Va. Copy-
right 1946 by the Army Ordnance Association, publisher, 705 Mills Building, Washington 6, D.C. Issued bimonthly. Single copy, 75¢ (by mail). Subscription rate: U. S. and possessions, $4.50 annually, in advance; foreign, $6.00.

Timken Axle-equipped 6-wheel vehicles carry, move and stop gigantic loads like this in Washington forests where steep grades are the rule.

Peace Insurance begins on jobs like this

Huge heavy-duty vehicles like this one are today licking bigger and tougher jobs than ever before in history.

Here's what this means to the Army:

These big civilian jobs provide a proving ground for bigger, heavier rolling equipment for the Army. New developments perfected here will enable us to help the Army keep ours the most advanced fighting equipment in the world. Peace insurance starts here.

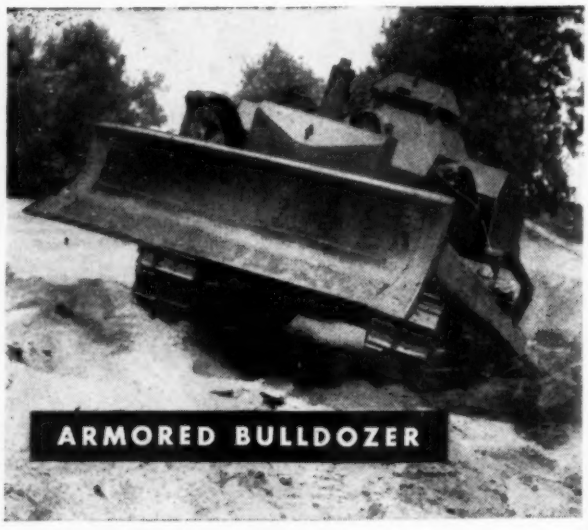
The Accepted Standard for Axles and Brakes for heavy-duty vehicles is TIMKEN. For 40 years, Timken engineers have worked closely with the Army to make our heavy military vehicles the biggest and best in the world.

Timken Axle Engineering Research will continue in the laboratories and in the field to advance still further our country's commercial hauling giants, and to co-operate in every way possible to make our military vehicles the world's best.

The Accepted TIMKEN AXLES Standard

TIMKEN AXLES

THE TIMKEN-DETROIT AXLE COMPANY, DETROIT 32, MICH.
WISCONSIN AXLE DIVISION • OSHKOSH, WISCONSIN
TIMKEN AXLE BRAKE DIVISION • DETROIT 32, MICH.



MILITARY VEHICLES

of all Types

Combat Tanks ★ Armored Cars ★ Scout Cars ★ Reconnaissance Cars ★ Officers Cars ★ Ambulances ★ Mobile Machine Shops ★ Artillery Tractors for guns of all sizes ★ High-speed Track Laying Artillery Tractors ★ Captive Balloon Winches ★ Air Field Service Tractors ★ Airplane Crash Trucks ★ Fire Equipment ★ Airplane Wrecking Trucks Mobile Aircraft Machine Shops ★ Mobile Oxygen Generator Units ★ Mobile Water Purification Units ★ Air Field Rotary Snow Removal Equipment ★ Air Field Fuel Servicing Trucks.

We are Specialists in the Design and Production of Military Transportation Equipment

MARMON-HERRINGTON CO., INC.

MANUFACTURERS OF ALL-WHEEL-DRIVE VEHICLES AND HIGH-SPEED TRACK-LAYING VEHICLES

INDIANAPOLIS, INDIANA, U. S. A.

Purveyors to U.S. Army, U.S. Navy, U.S. Marine Corps and Many Foreign Governments

New Developments

NEW ORDNANCE WEAPONS

New machines, instruments, and weapons are being designed and developed by the Ordnance Department as a result of experience gained in World War II as indicated below:

Artillery.—Antiaircraft equipment for accurately locating unseen targets at ranges of one hundred miles or more. Time of flight of projectiles from gun to target will be reduced by at least one-half. Radar plays a part in this, and velocities of 4,000 feet a second must be attained to ensure destruction of armor.

Range Finders.—Electronic range finders to replace optical types.

Large Weapons.—Large-caliber weapons for operations against heavily fortified defenses with shells accurate at long range to penetrate heavy armor plate.

Mortars.—Mortars which will deliver pay loads eight to twenty times that of the present 60-mm. weapon.

Aircraft Guns.—Automatic aircraft cannon of 20-mm. or more and special devices for air-borne troops. Cannon now being developed will be capable of firing projectiles at the rate of 1,500 rounds a minute. They are designed to destroy any airplane or sink lightly armored ships.

Tanks.—Improved tanks with supervelocity guns. Huge new self-propelled guns, such as 280-mm. howitzer motor carriage, are planned. Flying tanks, gliding from the air, are under consideration.

Ammunition.—Artillery ammunition of high velocity, capable of penetrating armor of six or more inches.

Rocket Missiles.—The Ordnance Department feels that rocket missiles will revolutionize warfare in the future. The atomic bomb has changed the picture. New bazooka has tremendous punch for blasting holes in armor. High-velocity aircraft rockets to be fired at machine-gun rates are being developed. A liquid-fuel rocket capable of attaining an altitude of 500,000 feet is being redesigned. Captured German V-2 rockets will rise over one hundred miles in flight tests far beyond the wildest dreams of yesterday.

Controlled Missiles.—Bell Telephone Laboratories is engaged in the development of an aircraft interceptor missile, and General Electric Company is studying a rocket for use against supersonic guided missiles. What is wanted is a missile capable of directing itself for hundreds of miles to an approaching target. The guided missile has suddenly become one of the most important weapons of today.

Recoilless Rifles.—The 57- and 75-mm. recoilless rifles are a great development for use in destroying tanks. A repeating and automatic mechanism for these weapons is being developed.

XP-84—NEW JET FIGHTER

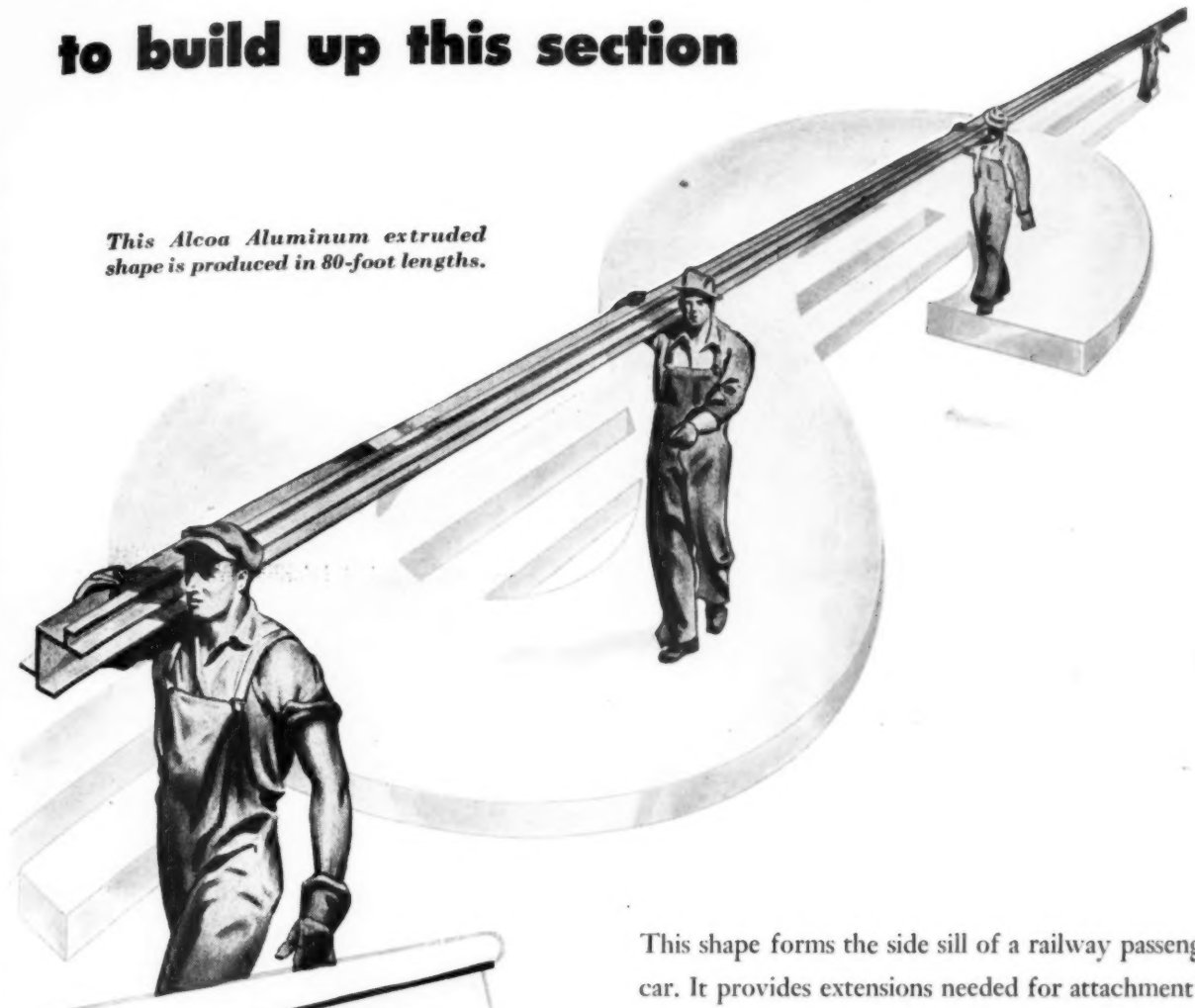
The AAF's newest jet fighter, the XP-84 was revealed recently to have a speed of more than 590 m.p.h., a service range of 1,000 miles, and a service ceiling of more than 40,000 feet.

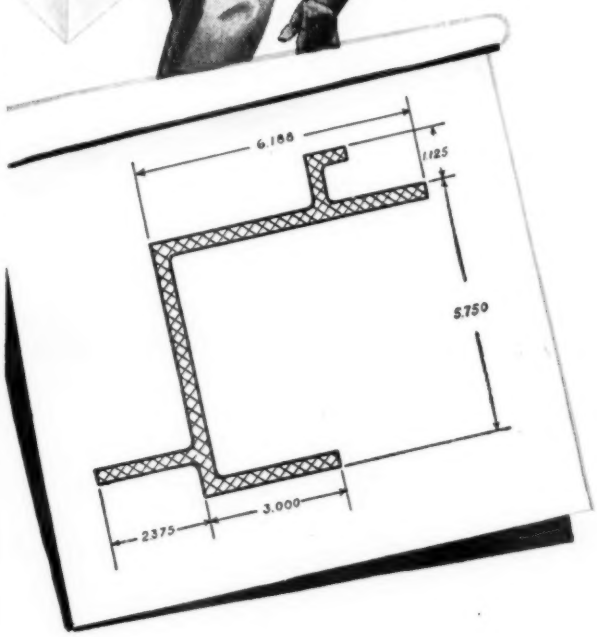
A sleek, flush-riveted, highly polished aircraft, the XP-84 is about the same size as the P-80. Having a tip to tip wing span of 36 feet 5 inches and an over-all length from nose to tail of 37 feet, the XP-84 is 1,000 pounds heavier than the Shooting Star.

Equipped with a tricycle retractable landing gear and powered by a General Electric jet engine, one of the most striking differences in outward design is the air scoop which is located in the nose of the plane instead of on the sides. (*Continued on p. 112.*)

Figure what it would cost you to build up this section

This Alcoa Aluminum extruded shape is produced in 80-foot lengths.





This shape forms the side sill of a railway passenger car. It provides extensions needed for attachment of every part. It is strong and dependable, yet doesn't contain a single pound of *needless* weight.

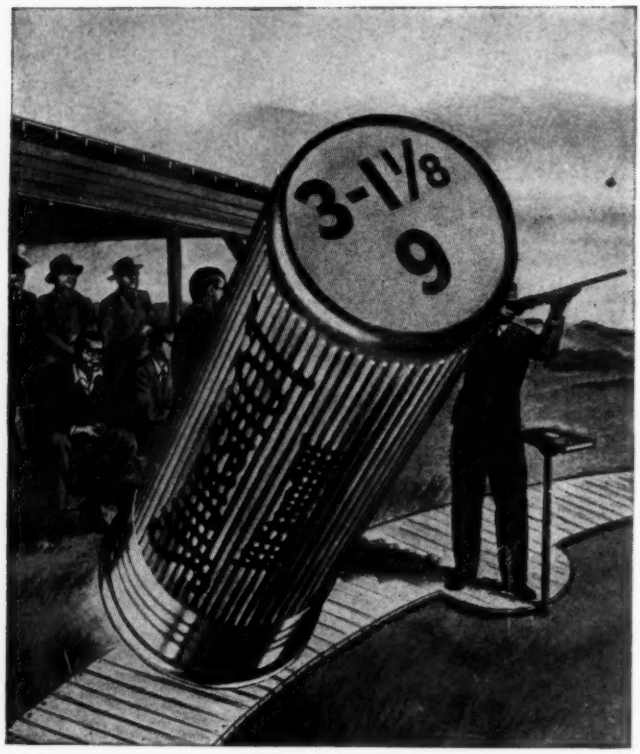
To build up this section, you'd probably rivet together channels, angles, and Z's. You'd have excess metal where one section overlapped another. You'd have the added weight of rivets. You'd pay for many hours of labor to assemble it. As one Alcoa customer put it, "We can't afford *not* to use extruded shapes."

For help on figuring how you can use Alcoa Aluminum extruded shapes to best advantage, call the near-by Alcoa office. Or write ALUMINUM COMPANY OF AMERICA, 2137 Gulf Building, Pittsburgh 19, Pa.

ALCOA FIRST IN **ALUMINUM**

ALCOA ALUMINUM

For Higher Scores at Skeet



Shoot "Shur Shot" Shells with NEW Remington Crimp

No more blown patterns! That's why Remington Shur Shot shells with the New Remington Crimp make skeet even more fun—scores even higher. This remarkable development by Remington eliminates the top wad which, in ordinary loads, gets in the way of the shot charge about 8 times out of every 100 shots, causing uneven distribution or wide scattering of pellets. The New Remington Crimp leaves no "holes" or thin areas for targets to slip through.

Remington Shur Shot shells have exclusive Kleanbore non-corrosive priming and uniform velocity to get the shot pattern out there *fast*. Also exclusive green, corrugated bodies, progressive burning powder, improved wet-proofing, and patented top seal.

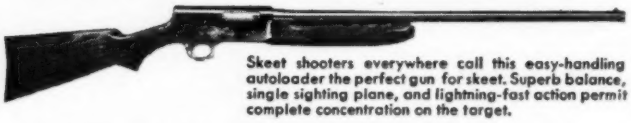
Made in 12-, 16-, and 20- gauge skeet loads and 12-gauge trap. For free literature, write Remington Arms Company, Inc., Bridgeport 2, Conn.

Remington

DU PONT

"If It's Remington—It's Right!"

Here's the Smooth-Swinging "SPORTSMAN"



Skeet shooters everywhere call this easy-handling autoloader the perfect gun for skeet. Superb balance, single sighting plane, and lightning-fast action permit complete concentration on the target.

Kleanbore and Sportsman are Reg. U. S. Pat. Off.; Shur Shot is a trade mark of Remington Arms Co., Inc.

New Developments

INDUSTRY UNDERGROUND?

The Army and Navy are reported well advanced in their plans for putting some of the Nation's key military plants and headquarters eventually underground as a precaution against atomic or rocket attacks in a possible future war. A committee of the reorganized Army and Navy Munitions Board surveyed underground sites for several weeks under the general supervision of a civilian industrialist, Richard R. Deupree of Cincinnati, Ohio, chairman of the Board. The work has included a study of the possible usefulness of such caverns as Mammoth Cave, Ky., and Carlsbad Caverns, N. Mex.

TARGET-FOLLOWING RADAR

One of the latest pieces of radar equipment in use in the British Navy is known as an A.F. device (automatic following). When radar warning of an approaching aircraft is received, a button is pressed on the A.F. equipment and the aërial immediately begins an automatic search of the sky. Within a few seconds it locates the target and "locks on" to it, indicating its achievement by a flashing green light. Then the aërial automatically follows the target, "memorizing" its course and speed if it passes behind another object, and the equipment passes a continuous flow of electrical information about it to the gun predictors.

NEW GUIDED MISSILE CENTER

All antiaircraft and guided missile activities of the Army Ground Forces are being coördinated at a new center established here. Maj. Gen. John L. Homer, deputy commander of the Panama Canal Department, is returning at once to assume new duties as commander of the antiaircraft and guided missiles center.

Plans call for extensive development and practical tests in the guided-missile field, with special reference to their related use as artillery weapons. One of the steps is the development of tactics and techniques and the organization of guided-missiles units for the Army Ground Forces.

MORE NAVY FIREPOWER

Navy ships and planes soon will have more firepower than ever before as the result of new developments in ordnance equipment. Director-controlled and power-driven, the Navy's new Mark 102 rocket launcher is now in service and is superior to all other rocket launchers because it can be trained, elevated, and depressed. It can maintain a continuous stream of accurately aimed 5-inch rockets at a rate of forty a minute, and thus would be of greatest use in close-range bombardment from light craft.

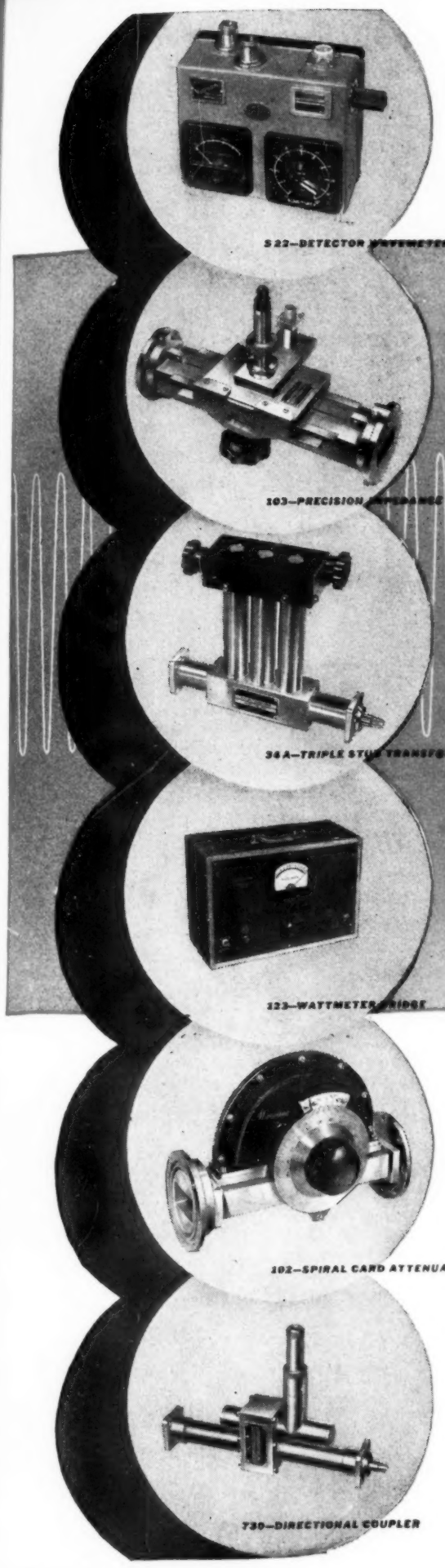
Although it still is under development, Navy spokesmen consider the new caliber .70 gun the most destructive antiaircraft weapon yet developed. Its accuracy, rate of fire, range, and damage effect is said to be many times greater than that of any other antiaircraft machine gun now known to be in existence. Fitting into a completely automatic machine gun mount, the gun will be equipped with a radar fire-control system by which the mount picks up enemy aircraft or missiles, tracks the target, and opens fire.

"Little brother" to this high-velocity antiaircraft gun is a twin 3-inch automatic gun mount designed to throw a heavier, faster VT-fuzed stream of fire into fast-moving aircraft and missiles. This mount is in production and is expected to be installed on new cruisers in about a year. It will supplant the present 40-mm. weapon.

Another revolutionary weapon which is completely automatic from ammunition-handling room to gun chambers is an 8-inch rapid-fire triple turret which will give a new class of heavy cruisers firepower at a rate many times that of any other 8-inch gun. *(Continued on p. 114.)*

PRECISION MEASUREMENTS IN MICROWAVE FREQUENCY BANDS . . . PROVIDED BY THE NEW

Sperry *Microline**



Adequate microwave test and measurement equipment is of vital importance both in laboratory and field. Sperry provides it in its comprehensive MICROLINE. Virtually every type of instrument, essential to precision microwave measurements, is represented in this new Sperry line. The instruments shown in the illustrations but partly suggest the wide range of Sperry Microline instruments, among which are included many new designs and developments for obtaining quick, accurate measurements in the microwave frequency bands. For more complete information regarding these Sperry instruments, and their applications to your individual problems and requirements, write our Special Electronics Department.

*Trade Mark

Sperry Gyroscope Company, Inc.

EXECUTIVE OFFICES: GREAT NECK, N.Y. • DIVISION OF THE SPERRY CORPORATION
LOS ANGELES • SAN FRANCISCO • SEATTLE • NEW ORLEANS • CLEVELAND • HONOLULU
Aircraft: Gyropilots • Gyrosyn Compasses • Attitude Gyros • Directional Gyros • Gyro-Horizons • Detonation Indicators • Automatic Radio Direction Finders • Instrument Landing Systems • Traffic Control Systems • **Marine:** Gyro-Compasses • Gyro-Pilots • Gyro-Magnetic Compasses • Incandescent Searchlights Steering Systems • Radar • Loran • **Industrial:** Railroad Radio • Microwave Relays Microline-Test Equipment • Klystron Tubes • Strobodyne • Knockometer

METALWORKING MACHINERY

Cold Headers for Bolts, Screws, etc.

Bolt Head Trimmers

Screw Thread Rolling Machines

Nut Forming Machines

Nut Tapping Machines

Screw Slotters

Rivet Drillers

Power Presses of all Kinds

Eyelet Machines

Small Arms Ammunition Machines

Collapsible Tube Machines

Thread Rolling Machines for Shells

Wire Drawing Machines

Rolling Mills for Sheets and Strips

Rod and Tube Mills

Flatteners and Straighteners

Gang Slitting Machines

Swagers, Pointers, Coilers, Winders, etc.

Special and Miscellaneous Machines

WATERBURY FARREL
FOUNDRY AND MACHINE COMPANY
Waterbury Connecticut, U. S. A.
SALES OFFICES:
CHICAGO CLEVELAND NEWARK, N. J.

New Developments

SEA WATER BATTERY

A device which saved the lives of many airmen downed at sea during the war led to the development of a tiny battery powered by sea water which appears capable of adaptation to many civilian uses. The battery was used in a tiny buoy, which, when thrown into the sea from a life raft, pushed up a rodlike antenna and began to emit automatic radio signals which could be picked up within a radius of fifty miles.

No longer than an elongated flower pot, the battery comes to life when dunked in water and, with the aid of a vibrator device, produces 330 volts for 12-hour transmission of radio signals.

INFRARED TELEPHONE

The Germans developed a Lichtsprecher (light speaker) which uses an invisible beam of infrared light to transmit telephonic messages through space. Light from an incandescent lamp is focused on a small mirror. Electric pulses corresponding to voice frequencies are amplified by tubes, causing the mirror to vibrate. With the vibration the light beam, reflecting to a distant station, is changed in intensity. A photo-sensitive receiver changes the intensity of the varying light pulses. These changes result in the production of audible sound in a telephone. Filters are used to blot out any visible light.

NEW TYPES OF WARFARE?

W. A. Higinbotham, chairman of the Federation of Atomic Scientists, said recently that there are at least two major secret weapons in existence which scientists believe are potentially as dangerous to mankind as the atomic bomb. He named "biological warfare" and "fission-product warfare, sometimes referred to as 'atomic poison gas'."

"There is a passive defense for the atomic bomb," he said. "Cities and industry might be dispersed at a cost of $300,000,000,000. But bacteriological warfare could be used to cut off the food supply; radioactive materials could be used to trap people in bomb shelters and caves."

THE HEAT DETECTOR—A NEW WEAPON

A device which is so sensitive that it can record the warmth of a man's body in the dark a quarter of a mile away was a secret weapon ready for action at the end of the war. These devices are built around tiny chemical substances which have such sensitivity that they can detect temperature variations as small as one-millionth of a degree Centigrade. The units built around these elements are known as thermistors.

Such thermistor-controlled devices can scan a darkened landscape and immediately record the presence of some infinitesimally warmer object, such as a man, when the object comes within their line of perception.

Some of these devices present their findings through a loudspeaker or earphones, or on graph paper, and others use the cathoderay-tube type of indication, as in radar. Unlike radar, however, they project no radiation of their own and thus cannot be detected by the enemy.

AGRICULTURAL ORDNANCE

Fifteen Army Ordnance plants will be converted temporarily from the production of explosives to the manufacture of nitrogen fertilizers for shipment to famine-ridden countries. About 3 months will be required to get the plants into production and 9 months to reach maximum production of 70,000 tons of ammonium nitrate monthly.

The Department of Agriculture said the amount of fertilizer produced each month will be sufficient to add ten million bushels to world wheat production, equaling the entire monthly grain needs of more than twenty million people. (*Continued on p. 116.*)

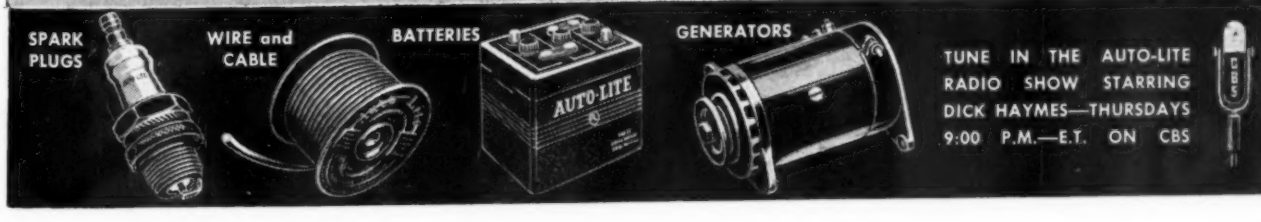
Switch to **AUTO-LITE**
ELECTRICAL PRODUCTS

Built by the organization that makes complete electrical systems for many of America's finest cars, trucks and tractors . . .

MONEY CANNOT BUY
BETTER ELECTRICAL PRODUCTS

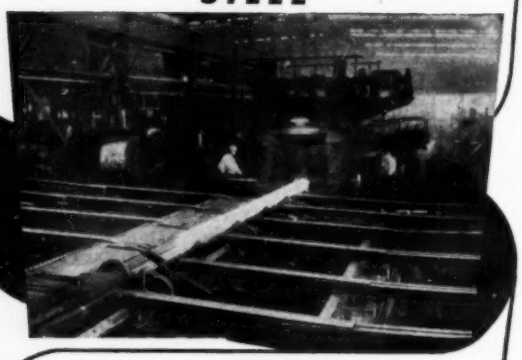
Leading automotive engineers pay tribute to the outstanding dependability of Auto-Lite products by specifying more than 400 Auto-Lite parts as standard equipment for finest cars, trucks and tractors. Such acceptance proves money cannot buy better products. Built in 24 great Auto-Lite plants these units include spark plugs, instruments, wire and cable, headlights, bumpers, plastic ornaments and panels, and complete electrical systems. A new booklet gives a more complete list of the many products Auto-Lite builds, alphabetically arranged for quick reference. Your copy will be mailed on request.

THE ELECTRIC AUTO-LITE COMPANY
Sarnia, Ontario — Toledo 1, Ohio

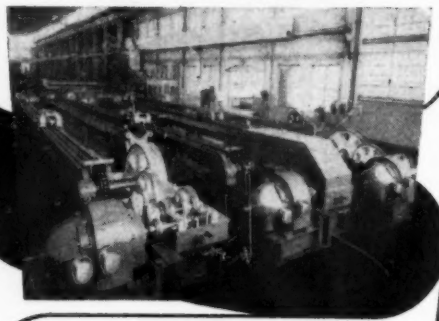


Designers and Builders to the

STEEL



NON-FERROUS



AND
OTHER INDUSTRIES

PLASTIC
RUBBER
CHEMICAL
FOOD
RAILROAD
OIL
MANY OTHERS

The

AETNA-STANDARD
ENGINEERING CO.

YOUNGSTOWN, OHIO

ARMY E NAVY

ASSOCIATED COMPANIES:
HEAD, WRIGHTSON & COMPANY, LIMITED
THORNABY-ON-TEES, ENGLAND
JOHN INGLIS COMPANY, LIMITED
TORONTO, ONTARIO, CANADA

New Developments

ATOMIC POWER FOR THE NAVY

Atomic-powered navies of the future will make the submarine a major fleet unit of greater importance than ever before, Rear Adm. H. G. Bowen, chief of the U. S. Navy's Office of Research and Inventions, predicted recently. Even with the present state of atomic-energy development, Admiral Bowen described the installation of atomic power for submarines as "a very attractive proposition."

"Since oxygen or oxygen-bearing fuel will no longer be required, we will be able to realize submerged speeds and submerged radii of action which will put the submarine in a distinct class by itself, and make it a major combatant unit," he stated.

On Navy ships he foresaw atomic piles replacing boilers to produce steam for driving turbines and reciprocating engines. Citing speculation that atomic piles may not be expected to weigh less than one hundred tons, the admiral stated that present weights of power units in Navy ships far exceed that amount.

200,000 DIAMETERS

The useful magnifying power of the electron microscope has been increased from 100,000 diameters to more than 200,000 diameters by an improved magnetic lens developed by Dr. James Hillier, aided by Perry C. Smith, at the RCA laboratories. Dr. Hillier succeeded in improving the magnetic lenses that focus the electron beams to such an extent that it is now possible to distinguish particles separated by as short a distance as 13 Angstrom units, or about 50 billionths of an inch. This means roughly that 50,000 distinct particles could be recognized in a distance equal to the width of a hair.

GUIDED ANTIAIRCRAFT MISSILE

It is anticipated that some of the bombers of the future will fly at altitudes far above effective antiaircraft gun ranges. It is difficult now for our pursuit craft to attack enemy bombers flying in formation because of the protection furnished by enemy bombers to each other. In order to solve this problem, the scientists at the Ordnance Department's Ballistic Research Laboratory at Aberdeen Proving Ground, Md., plan the development of a guided missile which would carry a charge intended to be exploded in the midst of an enemy bomber formation where it would be highly destructive.

Ordnance scientific strategists think that if enemy bombers are prevented by the threat of such a weapon from flying in formation, they will become vulnerable to the attack of individual fighter aircraft. Long-range planning by Ordnance scientists also forecasts the ultimate range of guided missiles to 20,000 miles—weapons capable of circling the globe.

MAGNETIC OIL SURVEYOR

A new era of oil exploration in which the underground structure of the earth's most inaccessible ocean, jungle, and mountain regions may be "mapped" from the air has been initiated by Gulf Oil Corporation. The new development, transformed during the war into a secret weapon for defeating enemy submarines, will tremendously speed up discovery of the world's remaining uncharted oil resources.

The "flying eye," or air-borne magnetometer as the device is technically named, represents the first practical means of oil surveying from the air, establishing the fastest known means for securing geophysical prospecting data of any kind and probably the cheapest.

Built around a sensitive magnetic detector to record for the geologist the intensity of the earth's magnetic field, the war magnetometer was adjusted to signal the presence of a submarine by indicating a disturbance in this field. Even radar could not detect underwater vessels. (*Continued on p. 118.*)

Leading Truck and Bus Operators Agree—

the best brake is AIR!

BENDIX-WESTINGHOUSE AIR BRAKES

Do you know why bus and truck lines overwhelmingly choose Air Brakes—Bendix-Westinghouse Air Brakes? It will pay you well to find out. Here is a capsule summary—**1.** Bendix-Westinghouse Air Brakes are the safest brakes money can buy. **2.** Bendix-Westinghouse Air Brakes make driving easier, cut driver fatigue, make better, safer schedules. **3.** Bendix-Westinghouse Air Brakes cost less in the long run, pay for themselves in lowered service costs. **4.** Bendix-Westinghouse Air Brakes are long-lived, often outlasting the life of the vehicle.

Get the facts on Air Brakes—Bendix-Westinghouse Air Brakes! Your distributor can show you how easy and economical it is to modernize your present equipment with them, or will help you select, for new equipment, the right Air Brake for the specific job.

BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY
ELYRIA, OHIO

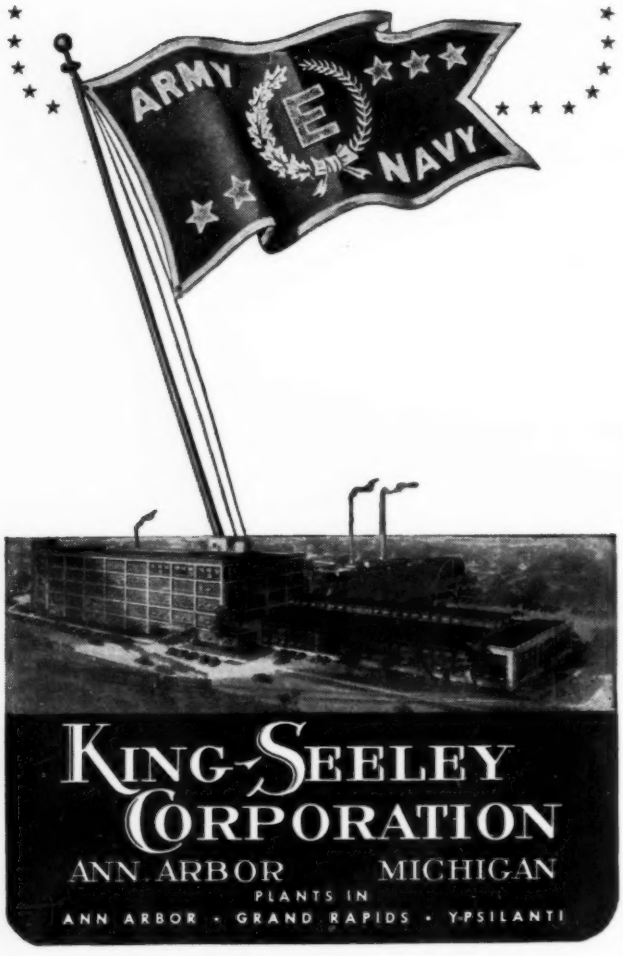
Bendix-Westinghouse AUTOMOTIVE AIR BRAKES

WORLD STANDARD OF SAFETY

KING-SEELEY'S Service Record

The records show that between February, 1941, and August, 1945, King-Seeley employees produced and delivered to our Armed Forces more than 385,000,000 pieces of special war materials. In addition to this, more than 1,000,000 pieces of regular production items such as governors, gauges, and speedometers for both combat and supply vehicles were produced.

We feel justly proud of this record and the sixth Army-Navy "E" Award given us May 12, 1945, in recognition of this accomplishment. If necessary, we can do it again, but right now we are devoting all our energy to the production of peacetime civilian goods to the end that all may enjoy true prosperity.



KING-SEELEY CORPORATION
ANN ARBOR MICHIGAN
PLANTS IN
ANN ARBOR • GRAND RAPIDS • YPSILANTI

New Developments

The present instrument, which is electronically operated, rides in a bomblike casing (called a "bird") trailed at some distance beneath the plane to eliminate magnetic interference.

FIRE-RETARDANT PAINT

Fire-retardant property of paint has been improved by adding aluminum powder to priming coats used in the interior of naval ships. The mixture used is obtained by adding eighty per cent aluminum paste to the primer in the proportion of one pound of the paste to two of the primer.

THE RAM JET ENGINE

Tests conducted during the past year have proved conclusively that the Navy's 70-pound ram jet engine—the first step beyond the turbo jet now used to propel high-speed aircraft—is a practical method of achieving supersonic speeds at high altitudes.

Consisting essentially of an open pipe, which gives it the nickname of "flying stovepipe," the ram jet scoops oxygen into a front opening during flight. The oxygen is compressed by the speed of the jet, fuel is injected and burned, and the exhaust streams out a rear opening. The impulse thus produced by the escaping hot gases thrusts the jet through the air at a velocity of from 800 to 1,500 miles an hour.

The ram jet has been tested by the Bureau of Ordnance for use in guided missiles and is highly regarded because it has no moving parts, no precision machine work, can be produced rapidly, and would sharply reduce the cost of expendable missiles. However, one disadvantage of the ram jet is that it must be brought to a high speed before it can operate efficiently. This must be done by catalpults or auxiliary rockets.

FLEXIBLE BODY ARMOR

Army Ordnance research technicians are striving to perfect flexible body armor which will give foot soldiers the same protection that halved the number of deaths among Air Corps personnel in World War II.

The mobility required of the modern doughboy makes it difficult for him to carry heavy equipment and weapons needed in the field. Ordnance technicians are attempting to develop armor which will provide protection without further impeding mobility. They have successfully equipped snipers and other infantrymen whose duties do not call for a high degree of mobility as well as tank crews, photographers, bulldozer drivers, and engineer personnel engaged in mine-clearing operations. But their crowning achievement has been the development of fliers' aprons, vests, neck, eye, groin and crotch protectors, popularly referred to as "flak suits" by Air Corps personnel in World War II.

AAF FACTORY TRAINING

In order to ensure fullest efficiency in the understanding and maintenance of aircraft, special factory familiarization training will be available to a limited number of military and civilian personnel assigned as key instructors and maintenance personnel, according to the Army Air Forces. Training will be planned by the manufacturers and conducted in their own plants. They will designate instructional materials, equipment, and training methods, and will be authorized to discontinue the training of any unqualified student.

Civilians eligible for this training must be Civil Service employees on duty with the AAF with extensive technical experience, leadership ability, and capable of instructing others. Military personnel must be members of the Regular Army or officers who have volunteered to remain on active duty until June 30, 1947, or for the duration of the emergency plus six months.

HIGH-TEMPERATURE GAS TURBINE

It was recently disclosed that successful operation at a gas temperature of 1,350 degrees Fahrenheit has been accomplished

Chicago and Northern Illinois—"A Department Store" for Industry

"I* make electrical relays and switches here in Chicago. My plant is small. A prospective customer recently called on me to place a substantial order. When he went through my factory he stated quite frankly he doubted my ability to produce the order. I asked him to reserve judgment and took him for a little excursion around the city. Within a few hours we visited my tool and die maker, a screw machine shop, three plating and finishing firms, (each a specialist in a different type of finishing), a metal fabricator and other suppliers.

"'You're not a small outfit, mister,' he concluded. 'You're in mass production with departments for every process at your finger tips.' He placed his order and I agreed to start delivery in 30 days . . . was actually shipping in three weeks. In today's market I find this diversity of facilities most helpful. To me, Chicago and Northern Illinois is a practical 'department store' of industry."

*Name on request

This true story typifies the war-time operations of thousands of Chicago manufacturers who could not hope to provide for every manufacturing process within their own walls. It helps to explain why this area became the nation's subcontracting center, producing by the war's end 23% of the nation's electrical machinery, for example, and 40% of the electronic equipment.

Utilizing cost-saving techniques, many small manufacturers in Chicago and Northern Illinois are today in mass production, despite limitations of inside facilities and capital investment. They have learned how to produce and make delivery from this industrial area easily, quickly, economically—and in large quantity.

Our staff of trained industrial engineers is prepared to answer any inquiries about the many economic resources of this area. On request they will make a special detailed study, for your business, of the various factors which make Chicago and Northern Illinois such a strategic industrial location. This work is carried on without charge. All inquiries are handled confidentially and promptly.

Industries locating in this area have these outstanding advantages: Railroad Center of the United States • World Airport • Inland Waterways • Geographical Center of U. S. Population • Great Financial Center • The "Great Central Market" • Food Producing and Processing Center • Leader in Iron and Steel Manufacturing • Good Labor Relations Record • 2,500,000 Kilowatts of Power • Tremendous Coal Reserves • Good Government • Good Living • **Send for free booklets containing useful information on these advantages.**

This is the tenth of a series of advertisements on the industrial, agricultural and residential advantages of Chicago and Northern Illinois. For more information, communicate with the

TERRITORIAL INFORMATION DEPARTMENT

Marquette Building—140 South Dearborn Street, Chicago 3, Illinois—Phone RANdolph 1617

COMMONWEALTH EDISON COMPANY • PUBLIC SERVICE COMPANY OF NORTHERN ILLINOIS
WESTERN UNITED GAS AND ELECTRIC COMPANY • ILLINOIS NORTHERN UTILITIES COMPANY

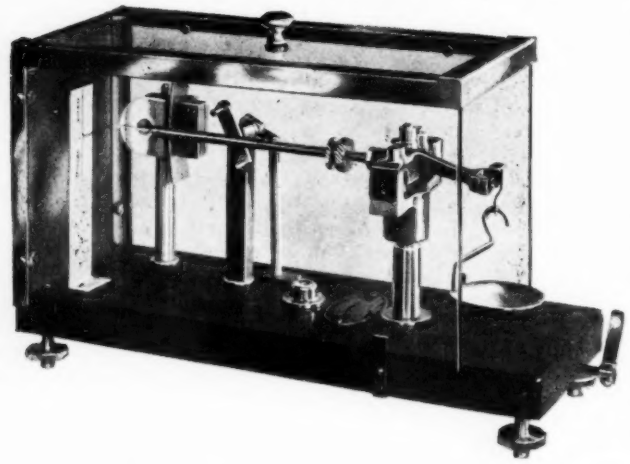
Atlas manufactured millions of firing devices in its regular plants for the Army and Navy during the war.

CHEMICALS ATLAS EXPLOSIVES

ATLAS
POWDER COMPANY
Wilmington 99, Delaware

INDUSTRIAL EXPLOSIVES
BLASTING SUPPLIES
PRODUCT FINISHES
COATED FABRICS
ACTIVATED CARBONS
CHEMICALS

For Grain and Gram Weights . . .



Fine weighing in grains and grams requires precision scales. Ordinary scales are too slow for production-line operation. EXACT WEIGHT Model UAB-9051 solves this problem by delivering accurate weighings with speed of operation. This scale (illustrated) is equipped with a magnetic dampener which checks lever oscillation to 4 beats, thus is capable of 15 weighings per minute. If you are engaged in any operation involving grain and gram weighing, write for complete details.

THE EXACT WEIGHT SCALE COMPANY
Columbus 8, Ohio Dept. W, Toronto, Canada.

Exact Weight Scales

in a series of tests on an Allis-Chalmers experimental gas-turbine plant installed in the U. S. Naval Engineering Experiment Station at Annapolis, Md. Designed and built for eventual operation with hot gas, at a temperature of 1,500 degrees Fahrenheit, the 3,500-horsepower unit is the first large multistage gas turbine for continuous power generation at high efficiency ever operated successfully at such high temperature. Although developed as a Navy project, its basic elements have characteristics suitable for both land and marine practice.

100,000,000-VOLT ATOM SMASHER

The Manhattan District Project of the Army Engineers, which developed the atomic bomb, has ordered a 100,000,000-volt atom-smashing X-ray machine from the General Electric Company. The machine is being obtained by the Clinton Laboratory at Oak Ridge, Tenn., which is operated by the Monsanto Chemical Company for the Manhattan District Project.

MOLTEN METAL AS A WEAPON

Postwar research and development activity in the Army Ordnance Department is gradually outmoding many standard weapons used in World War II. The high-explosive bullets and projectiles that fighter pilots pumped into enemy aircraft probably will be replaced in a few years by a high-speed metallic jet, traveling at an initial velocity of 25,000 feet a second. Hollow-charge anti-aircraft guided missiles would be sufficiently powerful to penetrate armor and destroy atomic or explosive rockets in flight, Ordnance scientists predict.

Theoretical analyses and high-speed X-ray studies conducted by the Ordnance Department at the Ballistic Research Laboratory, Aberdeen Proving Ground, Md., and other research establishments during the war have greatly improved the understanding of high-speed metallic jets produced by shaped charges.

Attacks against hostile missiles may be of two kinds: One may be the projection of a number of shaped-charge missiles which are penetrating, explosive, and incendiary, from an antiaircraft missile or guided missile at an armored guided missile target. The second method would be the projection of a high-speed metallic jet from a fighter aircraft in lieu of conventional bullets or projectiles.

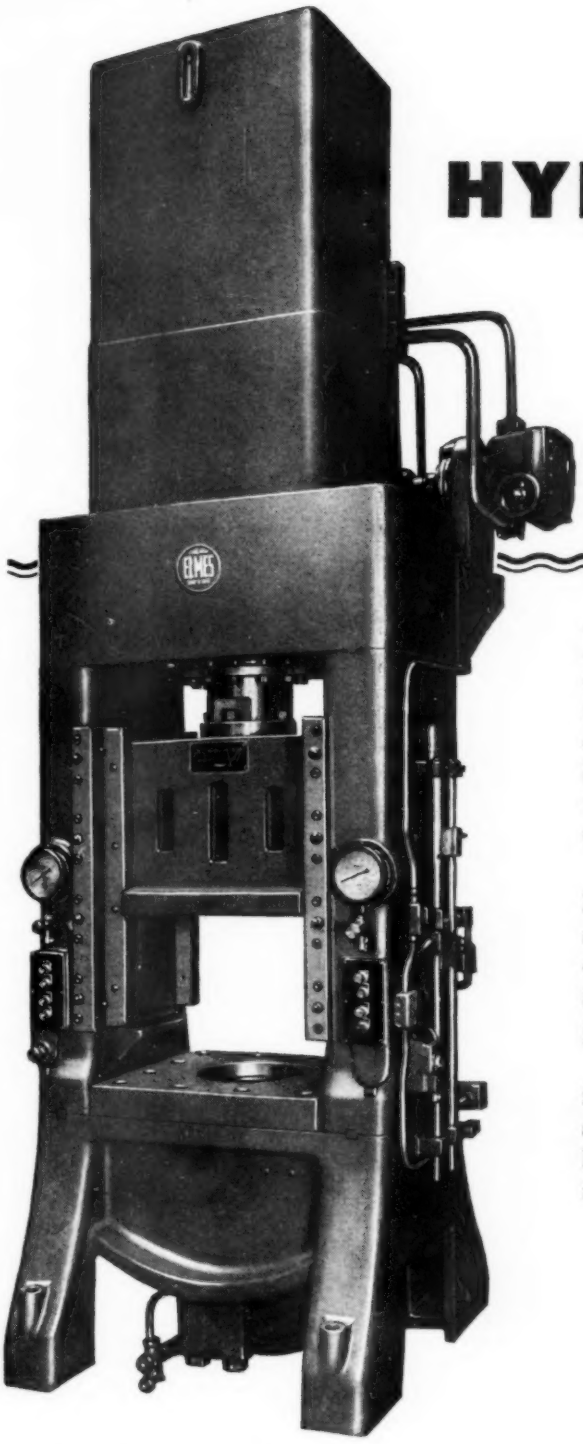
VEST POCKET SWITCHBOARD

A telephone switchboard weighing only 2¼ pounds, which in an emergency can take the place of the Army's 60-pound instrument, has recently been developed. Central feature of the revolutionary switchboard is the individual "switching unit," a transparent cube less than two inches wide, which is attached to the end of each telephone line. It has a 2-pronged plug, not unlike those used to plug in an ordinary electrical appliance, on the bottom and a jack into which the prongs of a similar unit may be inserted on the top. These, along with a minute gas-filled neon light and a device for limiting the amount of electric current to flow through it, comprise the unit. These component parts are embedded in a transparent plastic case. Seven of these units together with a standard Army field telephone are sufficient to handle the same traffic as a regular 6-line switchboard.

THE THIRD LOCK FOR PANAMA CANAL

Previous plans for the construction of a third set of locks at the Panama Canal are being reviewed in the light of recent war experience. The study is being made to determine whether changes in design will be necessary, and no indication was given as to when a final decision would be reached. The Third Locks Project was originally authorized by Congress in August 1939 for purposes of national defense and in anticipation of the great expansion of commercial traffic through the Canal. The cost of the project was not to exceed $277,000,000.

Actual work was begun on July 1, 1940, but with the outbreak



HYDRAULIC FORCE *has many uses*

Practically everyone knows that hydraulic pressure created hundreds of thousands of shell blanks—shaped steel plate at shipyards—formed airplane propellers and countless other combat essentials. Hydraulic presses have long been famous for their *power to produce,* but wartime ingenuity put this versatile force to many other uses.

Elmes hydraulic equipment tested landing gears for Flying Fortresses; charged and sealed large projectiles and rockets; disassembled heavy munitions at front line depots for spot checks on uniformity; provided processing pressures requiring pump deliveries up to 35,000 pounds per square inch.

Convenient, controllable, *irresistible* hydraulic power is a mighty force in any production program—in *any* application where pressure is required. We'll be glad to help you put this mighty force to work in keeping America strong.

Self-contained Elmes metal-working press for drawing, forming, bending, coining. Selective stroke, speed, and pressure. Rapid approach, pressing, and return of slide and cushion. Automatic reversal and speed change at any selected slide position or pressure. Single- or double-action. Full push-button control.

ELMES

Since 1851

HYDRAULIC EQUIPMENT

ELMES ENGINEERING WORKS *of* AMERICAN STEEL FOUNDRIES
1004 Fulton St., Chicago 7, Ill.

Also Manufactured in Canada

METAL-WORKING PRESSES · PLASTIC-MOLDING PRESSES · EXTRUSION PRESSES · PUMPS · ACCUMULATORS · VALVES · ACCESSORIES

SEE below the SURFACE

Add Sales Appeal to Rust Prevention . . .
with the NEW
TRANSPARENT
NOX RUST
CLEARCOAT #626

The first transparent rust preventive to meet rigid government AXS 673 specifications, Nox Rust ClearCoat No. 626 not only PROTECTS but PRESENTS your products. Surface condition, stencilling and markings that are hidden by conventional coatings can be instantly inspected. After years of research Nox Rust chemists have scored another first.

Product surface, condition and markings hidden by conventional opaque films but clearly visible through Nox Rust ClearCoat.

ClearCoat No. 626 features: highly transparent . . . complete protection . . . satisfies AXS 673 specifications . . . solvent type . . . easily applied by dip, brush or spray . . . for all metals . . . economical to use . . . adds unusual sales appeal to finished metal parts.

Engineered recommendations based on our years of experience in this field are available for your corrosion problems. Write today for complete details on Nox Rust ClearCoat and other outstanding protective coatings.

SAVES METAL

Chemicals for American Industry
NOX-RUST
CHEMICAL CORPORATION

SAVES MONEY

New Developments

of the war and the subsequent shortage of critical materials, the project was greatly modified on May 26, 1942. Work was continued on a limited scale, however, and a large part of the dredging and excavating operations has been completed.

A NEW ROCKET ENGINE

The Navy has announced the development of an experimental rocket engine labeled "Moby Dick," described as the most powerful in existence. Moby Dick generates 66,000 pounds of thrust for 2 seconds—one-third more driving force than that of the German V-2 rocket. The Moby Dick is a 105-inch long cylinder, 17 inches in diameter. It weighs 1,500 pounds, half of which is the solid propellant which supplies the power.

CANNING ORDNANCE

Army Engineers have authorized by contract the erection of 569 Army-owned, standard bolted steel tanks to house Ordnance equipment. The tanks will be erected in varying numbers at Ordnance plants and arsenals in different sections of the United States.

The estimated cost of erecting these tanks, which are of two sizes, will be $2,187,838. This will include humidifiers, which will be used to extract the humidity from the air inside the tanks.

SPRAY PACKING MACHINERY

A new Quartermaster method of storing weather-sensitive machinery holds promise of application to agriculture machinery which farmers are forced to leave in the open during long winter months. The procedure, known as "spray packing," consists of enveloping machines in a cheap weather-resistant material resembling leather and then subjecting it to four spraying operations.

To form the cover or envelope over the machinery, a frame or network is built around the object with scotch tape or similar material in a manner that will not present any openings wider than sixteen inches. When the object is thus completely caged, the first spray, called the "webbing agent" is applied with a spray gun.

NEW AIR-BORNE RADAR

Lightweight air-borne radar equipment, employed on a scheduled transport operation for the first time when a C-54 flew from Westover Field, Mass., to Paris, France, recently, promises to make a considerable contribution to safety in flight.

This trans-Atlantic trip marked the first extended range use of lightweight air-borne radar equipment installed and utilized for the purpose of aiding an aircraft to complete successfully a scheduled flight. The new development will aid in making flights safe in all kinds of weather.

BOSS of the BULLDOZERS

THERE'S a new champion among bulldozers today. Designed, built and put through the stiffest of job-tests by Caterpillar Tractor Co., the new "Caterpillar" Bulldozer entered the earthmoving field a year ago. Its success has been immediate and unqualified. When you talk to old hands in the business who have used them all, they'll tell you without hesitation that this machine is writing new history in fast, economical earthmoving.

Among the many outstanding advantages of the "Caterpillar" Bulldozer are these:

1. The scientific curve of the blade rolls the earth ahead instead of shoving it—producing greater capacity and lower yardage costs.

2. With the famous "Caterpillar" Diesel Tractor, this 'dozer is a matched, perfectly balanced work unit. Tractor and 'dozer are both built by the same experienced manufacturer—both sold and serviced by the same well-equipped dealer.

3. It can be mounted and demounted quickly, with none of the inconvenience of an overhead frame.

4. Extra-hard steel gives the blade edge long, durable life.

5. Cable controls are fast, sure-acting, easy to operate, and cables and sheaves are protected from dirt-clogging.

"Caterpillar" Bulldozers with straight or angling blade are available for the three larger sizes of "Caterpillar" Diesel Tractors and they'll make a lot of dirt fly in the great earthmoving days that are ahead.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

CATERPILLAR DIESEL

REG. U.S. PAT. OFF.

ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT

—for lowest costs on earth

TAKE THAT GRINDING PROBLEM UP WITH BAUER BROS.

Builders of hammermills, attrition mills, and special mills for grinding of wood pulp, feathers, peanut shells, metals, etc.

Operators of a complete experimental grinding laboratory to which come many unusual and difficult grinding problems for study and possible solution.

THE **BAUER BROS.** CO.
SPRINGFIELD, OHIO

Bauer

COMMUNIQUES *from the File Front*

"Situation well in hand . . ."

Yes—the files and filing situation are well in hand in plants the country over where faster-cutting NUCUT Files are speeding war production.

HELLER BROTHERS COMPANY
America's Oldest File Manufacturers
Good Tools Since 1836
865 Mt. Prospect Ave., Newark 4, N. J.

Awarded to the Newcomerstown, Ohio, Plant

HELLER NUCUT WAVY TEETH FILES

Professional Digest

GERMAN GUIDED MISSILES—PART II

In addition to the guided missiles described in the July-August issue, the Germans also employed other types. Much attention had been given by the Germans to the air-to-air weapon for use against bomber formations. In addition to the somewhat clumsy Henschel Hs 298, the Germans had developed and used experimentally a rocket-propelled guided weapon known as *X4*. This missile consisted of a well-streamlined torpedolike metal fuselage with four swept-back wooden wings and a cruciform metal tail unit. The nose section of the fuselage contained the 110-pound war head, detonated by a fuze housed in an 11-inch projection forming the nose. The center section housed the liquid propellent fuel, while the rear section contained the gyroscope, battery, and electrical services, with the propellant outlet in the extreme tail.

X4 was carried by Focke-Wulf Fw 190 fighters, being suspended from a modified 70-kg. bomb rack. On approaching a bomber formation, X4 was released and flew ahead of the parent airplane, using its own rocket fuel and being controlled from the Fw 190 by means of electrical signals sent along the two 0.22-mm. insulated wires connecting the missile to the fighter. Six kms. of this wire were carried in each of the two metal bobbins fixed to the X4. These bobbins, twenty-four inches long, were mounted at the tip of the lower port and upper starboard wings.

Flight control, as distinct from remote control, was achieved by comblike spoilers on the tail fins—these spoilers had a maximum movement of one-tenth of an inch. The other wing tips carried an aiming flare. Having a top speed of about 620 miles an hour, X4 was already in quantity production. Data: Total length, 6 feet, 8 inches; span from wing tip to wing tip, excluding diameter of bobbins and flares, 1 foot 7 inches; maximum fuselage diameter, 8½ inches; span of tailplane, 10¾ inches.

Bv 246 was a glider bomb used for attacks on allied shipping. In layout, the Bv 246 was a shoulder-wing cantilever monoplane with twin fins. The fuselage, eleven feet in length, was of metal construction built in four sections, the front and rear sections being joined aft of the trailing edge, while both front and rear sections were each built in two pieces, the top and bottom halves being welded together.

The wing was the most interesting feature as it was made of concrete with a metal-mesh core, being built in two sections attached to the side of the fuselage and faired at the roots. This wing had a span of 21 feet 1 inch, an area of 14.4 square feet, and the unique aspect ratio of 34. There were no ailerons.

Although there were two fins attached at the ends of the cantilever tailplane, only the port fin incorporated a rudder. Small elevators were fitted. Wooden pegs protruded from the top and bottom of both fins in the Bv 246 shown at Farnborough; there was no apparent reason for these fittings, but a photograph published in *The Aëroplane* on August 17, 1945, showed guide flares fitted above each fin.

Three of these glider bombs were carried beneath the Heinkel He 177 and two under the Junkers Ju 88, Ju 188, Ju 388, and Dornier Do 217. Some form of radio control was fitted, although no aërials were visible on the specimen examined. The total weight of the missile was 1,600 pounds, of which about 1,000 pounds was taken up by the war head.

In addition to the actual weapons under development, Germany had produced a number of purely experimental missiles, and the example in this category shown at Farnborough was the *Feuerlilie 25*. This was developed for ballistic and aërody-

Here Is Our Proposal:

MAKE A TON OF SHEET STEEL GO FARTHER—PRODUCE MORE GOODS

The Trend of American Industry Suggests the Method

This is not a radical idea. It is in keeping with an established trend in industry to adapt better metals to the job, and make them "pay their own way" through more efficient design and production. Sometimes the goal has been to improve product performance, eliminate excess weight, or simplify fabricating operations. Today, the primary goal of practically all metal-working industries is to *get more production—make a ton of steel produce more goods.*

High-Tensile Steels Provide the Way

High-tensile, low-alloy steels have the properties needed to attain this objective. By taking advantage of their higher yield and tensile strengths and great corrosion-resistance, designers can reduce sections as much as 25% in a wide range of applications now built of carbon sheet steel—and still retain the same strength and durability. Metallurgy takes the place of mass to boost production per ton of steel.

Our Estimate: One Extra Product for Every Three You Build

We have worked closely with manufacturers on the application of N-A-X HIGH-TENSILE steel for varied parts and products. We know what can be accomplished with this fine-grained, low-alloy steel. It is our estimate that production of units per ton can be increased as much as 33% by replacing heavier sections of carbon sheet steel with lighter sections of N-A-X HIGH-TENSILE. And because of the good formability of N-A-X HIGH-TENSILE, exceptional in such a high-strength steel, the change-over can be accomplished without serious problems in fabricating.

Our Challenge: Look at Over-All Costs

We also believe that the higher cost of N-A-X HIGH-TENSILE, compared to carbon sheets can be compensated by production economies, over and above the savings in steel effected by its high strength. Greater corrosion-resistance, freedom from age-hardening and embrittlement, and increased resistance to "set" when bent may reduce handling costs. Exceptional formability and other desirable characteristics of N-A-X HIGH-TENSILE make possible the elimination of intermediate annealing between draws in many cases. Also, finer grain structure and higher hardness produce a smoother surface texture when drawn or stretched, resulting in a saving of metal finishing or in a higher degree of finish when painted or plated. These and other manufacturing advantages of N-A-X HIGH-TENSILE can be utilized to make N-A-X HIGH-TENSILE "pay its own way" on the basis of *over-all costs.*

We would like to work with you on your problems. We believe N-A-X HIGH-TENSILE will produce one extra product for every three you build.

MAKE A TON OF SHEET STEEL GO FARTHER
Specify—
N-A-X
HIGH-TENSILE STEEL

GREAT LAKES STEEL *Corporation*

N-A-X ALLOY DIVISION • DETROIT 18, MICHIGAN
UNIT OF NATIONAL STEEL CORPORATION

COPYRIGHT 1946, GREAT LAKES STEEL CORPORATION

★ ★ ★ ★ ★ ★

42 YEARS OF
Spicer
SERVICE

UNIVERSAL JOINTS
★ ★ ★
PROPELLER SHAFTS
★ ★ ★
TRANSMISSIONS
★ ★ ★
POWER TAKE-OFFS
★ ★ ★
TORQUE CONVERTERS
★ ★ ★
PASSENGER CAR AXLES
★ ★ ★
PARISH FRAMES
★ ★ ★
CLUTCHES

Spicer MANUFACTURING CORPORATION
★ TOLEDO, OHIO ★

Whatever your fuel or lubrication requirements may be

GULF

Gulf manufactures quality products to fulfill your needs.

GULF OIL CORPORATION
AND GULF REFINING COMPANY
General Offices—PITTSBURGH, PA.

namic research at the Hermann Göring Research Institute at Volkenrode, near Brunswick. The Feuerlilie 25, which was of all-metal construction, had a total weight of 264 pounds.

The missile had a long, cylindrical fuselage with a maximum diameter of nine inches and a long, pointed nose. The midcantilever wing was placed far back, the whole wing being swept back and also sharply tapered in chord. With a total span of 3 feet, 8½ inches, the root chord was 25¼ inches, while the tip chord was only 7½ inches.

Propulsion was by rocket powder burning for six seconds, the exhaust gases passing out through the rear of the fuselage. Symmetrical fins were mounted above and below the rear of the fuselage, each fin carrying a cantilever tailplane, the upper tailplane having an elevator. Lateral control was achieved by small ailerons at the tips of the main wings. These ailerons were actuated by means of electromagnets mounted in the wing-tip fins, these in turn being controlled by a gyroscope housed in the fuselage.

Feuerlilie 25 was launched from an inclined ramp at an angle of sixty to eighty degrees and aiming was assisted by guide flares attached to the tips of the vertical fins. The total length of Feuerlilie 25 was 6 feet, 6 inches; the span of the tailplane was 13¾ inches.

In addition to the weapons dealt with in detail here, this particular section of the Farnborough exhibition included a variety of German mines and bombs, among them the fat SA 4,000-kg. bomb and the FX 1400 radio-controlled armor-piercing bomb.

The *FX 1400* was used for antishipping operations, including an attack against ships at Plymouth in April 1944. This bomb was dropped from 20,000 feet, aimed by a normal bomb sight. After its release the parent airplane slows down and climbs to bring itself into line with the bomb and the ship. The bomb aimer then sends radio-control signals to the bomb to keep the three in line until the bomb hits.

Also of interest was what is probably best described as a "sabotage set." It consists of a large wooden bomblike container housing three men who are dropped in this structure by parachute. Two of these units could be carried by a Junkers Ju 88.

Among German long-range rockets the *A9* was fitted with wings enabling it to glide, thereby increasing its range. The addition of wings brings it even closer to the Wasserfall design already described.

A10, in the project stage only, was a 2-stage rocket consisting of an A9 attached to the A10 unit which acted as a giant booster rocket to be jettisoned after carrying the A9 into the stratosphere. In this project the system adopted in the Rheintochter again appears. Hitler's drive for new techniques in air warfare had certainly borne fruit.

No description of German antiaircraft weapons would be complete without some details of the *Bachem BP 20 Natter* (Viper). Natter was in an early stage of development, but at least one experimental launching had taken place. This advanced project fitted into a category between the interceptor-fighter and the guided rocket projectile evolved for the defense of specific targets.

Launched from a ramp at an angle of 75 degrees, the Natter had assisted take-off provided by two solid-fuel rockets which were jettisoned at about 5,000 feet. At this height the Walter HWK 109–509 bifuel rocket motor provided the thrust. The climb was ground controlled but the pilot located in the nose took over for the actual interception. After attacking the hostile bomber formation with rocket projectiles the pilot and rocket motor returned to earth by parachutes.

The V-2 rocket is propelled by the reaction or recoil from the expulsion at high velocity of a jet of gases produced by alcohol and liquid oxygen burning at high pressure in a carefully designed combustion chamber with a suitable venturi nozzle.

ONE MORE STRAW—ONE LESS CAMEL!

Many centuries ago the weight of one last straw broke a camel's back. Thus somebody's artless optimism about the strength of a vital part wrecked a perfectly good materials handling system.

Today it is plain, cold fact that ignoring the depressing effect of low temperatures on the impact strength of vital steel parts can be a short cut to a long line of avoidable, costly troubles.

The solution for the problem in the fable was less load or more camel. For the modern problem the answer is a molybdenum steel that combines the deep hardening and freedom from temper brittleness necessary to provide good low temperature impact strength.

MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"
CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

Climax Molybdenum Company
500 Fifth Avenue · New York City

MOLY

CONTINENTAL
Foundry & Machine Company
PITTSBURGH · CHICAGO
•
SPECIALIZING IN
Carbon and Alloy Steel Castings
Alloy Steel, Iron and Alloy Iron Chilled Rolls
Rolling Mills and Steel Plant Equipment
Special Machinery

CHICAGO WORKS
East Chicago, Ind.

PITTSBURGH WORKS
Coraopolis, Pa.

WHEELING WORKS
Wheeling, W. Va.

WARWOOD WORKS
Wheeling, W. Va.

Improved Athey Mobiloader

★ NEW! More Stability-Better Vision
★ NEW! Hydraulic Control
★ NEW! Improved Bucket Design

ATHEY PRODUCTS CORPORATION
5631 W. 65th St. Chicago, Ill.

Professional Digest

According to a well-known principle of physics, the total rearward momentum of the gases equals the total forward momentum of the rocket when burning ceases, plus any momentum used up in overcoming the effects of gravity and drag.

As fired against London, about 14,000 pounds of gas expelled at an average velocity of 6,800 feet a second gave about 10,000 pounds of rocket and unburned propellants a forward velocity of 4,900 feet a second when the fuel supply was cut off and burning ceased. This happened about 60 seconds after the take-off when the rocket had traveled 25 miles along its trajectory and was moving in a direction 47 degrees away from the vertical at a point 17.5 miles above the ground 15.5 miles longitudinally from the launcher.

During the burning period, the direction of the rocket is controlled by the action of two sets of movable vanes associated with the two pairs of fins. Each of these two sets consists of a pair of graphite vanes in the jet of propellent gases and a pair of metal vanes in the air stream at the outer edges of the fins. One set is controlled by a gyroscope so as to maintain the axis of the rocket in the vertical plane through the launching and target points, thus making the rocket go in the right direction. The other set of vanes is controlled by another gyroscope so as to produce and maintain the correct inclination of the trajectory during the burning period.

This second gyroscope is subject to the control of a third gyroscopic system, the real brains of the missile, which serves to maintain vertical travel to a height of about one mile, then to tilt the rocket slowly away from the vertical until it travels on the desired course, thereafter to maintain this course until the velocity is correct for the range desired, and, finally, to cut off the fuel supply at that velocity, thus ending propulsion. Fuel cutoff can also be accomplished by remote control from the ground. After jet propulsion has ceased the rocket behaves like a projectile fired with the same speed and direction from a gun.

SQUARE-TIPPED PROPELLERS

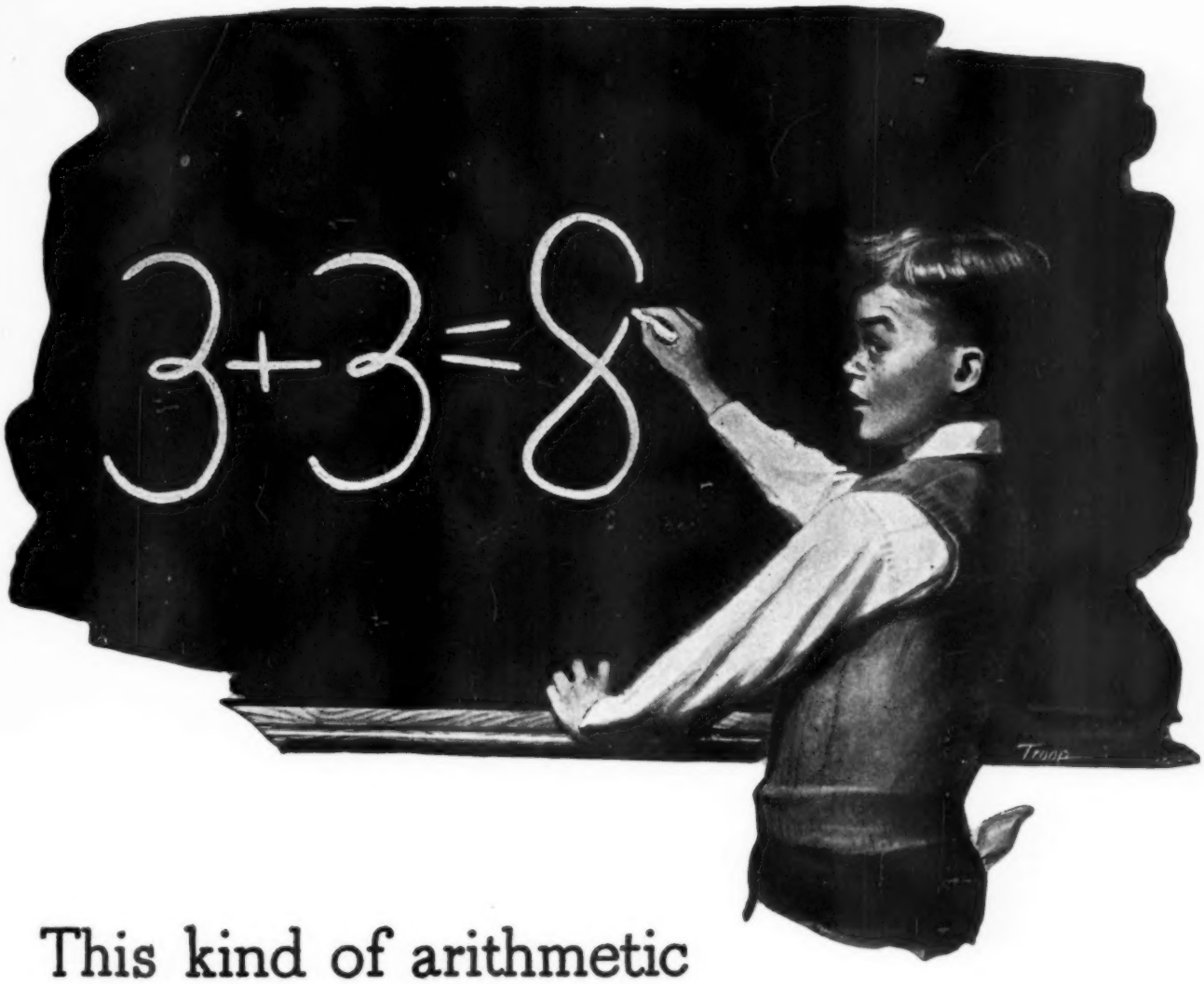
A new type of propeller, similar in appearance to old-fashioned windmill vanes, will soon appear on some of America's newest transport aircraft. Square-tipped instead of elliptical, and almost rectangular in shape, the propeller is the result of aërodynamic research designed to maintain high propeller efficiencies as airplane speeds approach the supersonic stage.

The new blade and the old windmill vane have square tips and maintain the same width from butt to tip. In addition, some variations of both are even wider at the tip than at the butt. Just as the square tip proved to have the most efficiency for absorbing the wind's energy and transforming it into mill power, so has it improved the function of a propeller blade by absorbing high power efficiently for transformation into thrust.

Designed by the Hamilton Standard Propellers Division of United Aircraft Corporation, the square-tipped blade has answered three major problems: (1) efficient absorption of greater horsepowers required for high speeds; (2) reduction of energy losses resulting from increased blade drag and propeller slipstream momentum; (3) the minimizing of compressibility losses suffered by conventional propeller blades at high speeds which cut operating efficiencies to below acceptable requirements.

Width added at the tip affords maximum increase in blade power absorption with minimum weight increase, thus permitting the design of lighter blades. Because the square tip carries the airfoil section for the blade's entire length, it is unnecessary to distort the airfoil design at the tip as was required with the round-tip blade.

This design allows for superior blade performance. In addition it permits the use of a thinner, less cambered airfoil at the tip, resulting in a substantial reduction of the effects of compressibility. Faster, more efficient aircraft may therefore be expected in the future.



This kind of arithmetic may put Johnny through college

Here's how it works out:

$3 put into U. S. Savings Bonds today will bring back $4 in 10 years.

Another $3 will bring back another $4.

So it's quite right to figure that 3 plus 3 equals 8 . . . or 30 plus 30 equals 80 . . . or 300 plus 300 equals 800!

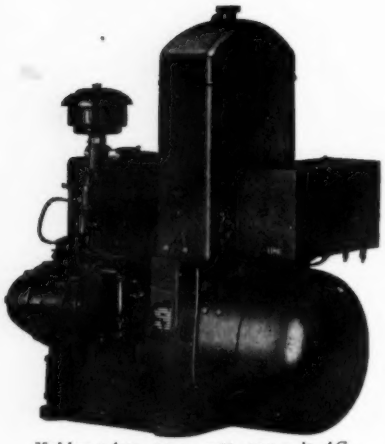
It will . . . in U. S. Savings Bonds. And those bonds may very well be the means of helping you educate your children as you'd like to have them educated.

So keep on buying Savings Bonds—available at banks and post offices. Or the way that millions have found easiest and surest—through Payroll Savings. Hold on to all you've bought.

You'll be mighty glad you did . . . 10 years from now!

SAVE THE EASY WAY... BUY YOUR BONDS THROUGH PAYROLL SAVINGS

Contributed by this magazine in cooperation with the Magazine Publishers of America as a public service



Kohler 1A21, 1500 watt, 115 volt AC, fully automatic.

No Current Failure with a KOHLER

Kohler Electric Plants are highly efficient as an emergency source of light and power, or as steady, reliable, continuous power for remote areas in need of electricity.

Being compact, efficient, and economical, Kohler Electric Plants can be used for every conceivable need. Every Kohler Plant is backed by 73 years of manufacturing experience. Write for information. Kohler Co., Kohler, Wisconsin. Established 1873.

KOHLER OF KOHLER

DEAD BIRD!

For skeet, waterfowl or upland game Savage automatic shotguns have the built-in balance, fine handling qualities, and unfailing dependability that give the shooter every advantage. See these great guns at your dealer's.

Savage Arms Corporation
Utica, N. Y.
Operating plants in Utica, N. Y. and Chicopee Falls, Mass.

SAVAGE

Savage Automatic Shotguns, in both standard and lightweight models, are now in production.

Communications

COMPLIMENTS

THE EDITOR.—The writer wishes to compliment you on your Bulletin No. 68, dated June 15th. The things you say about General Eisenhower are confirmed by the writer who heard his message and considers it extremely timely. It is only too bad that many of the editorial notes you have written in your Preparedness Bulletin cannot get a wider distribution because you do not mince words and you come to the point on the problems involved.

M. B. HAMMOND

Coraopolis, Pa.

HISTORY—NOT FLAGPOLE SITTING

THE EDITOR.—Having devoted much of my time for many years to furthering the cause of American military history, I was intensely interested in Neil Swanson's "American History Has Failed Us," in the May-June issue of ARMY ORDNANCE (Vol. XXX, No. 156, p. 302). Congratulations are in order for both author and magazine, for thought and publicity on this vital theme are always welcome.

With Mr. Swanson's thesis that our historical writing has failed to reach the bulk of the American people and with his evaluation of the terrible significance of that failure, we must perforce agree. His plea that the general level of writing be raised—that history be vitalized—is all the better for his cogent showing of the line and the method which will achieve that end.

However, I believe that there is one rather grave error in Mr. Swanson's implied conclusions. Not only are the fairly large and swiftly growing number of military biographies which tend largely toward Swanson's method ignored, but to hold that flat and uninteresting writing is the only or even the chief cause of the failure does not ring true. And it is dangerous in that it blinds us to other grave reasons.

An educational system which idiotically reduces history to the level of a "social science" seems to be greatly to blame. And surely pacifism, politics, the uninterested teacher, and the self-interest which asks "How will military history *pay me?*" cannot be held guiltless.

History can and should be made interesting to the thinking American, but it can't compete with the comic strip, racing news, and radio gags for the all-too-prevalent type of mind which hates to exert itself. While improving history along the splendid lines suggested by Neil Swanson, don't forget to pull along educational and recreational standards, so that good history won't look —and be—so much like a flagpole-sitter!

Washington, D. C. F. W. FOSTER GLEASON

"LESS CONFUSION"

THE EDITOR.—I cannot refrain from some comments concerning your Industrial Preparedness Bulletin. I read, out of natural interest in my country and the times we live in, everything from Spengler to *Time* and *Business Week*, but it is my sincere opinion that none of them are better informed, show more penetrating thinking or a sounder grasp of fundamentals than your Bulletin. The writing, too, is expressive and of a high order.

I put my Industrial Preparedness Bulletins into the hands of as many people as possible. I believe that the more who read them, the less confusion there will be in our country. My hat is off to you!

Dayton, Ohio. ROBERT GRAHAM

For New Installations
or Replacement Needs

USE BROWN & SHARPE PUMPS

THAT ARE BUILT FOR THE JOB

Supplying Coolant
Circulating Liquids
Supplying Lubricant
Transferring Liquids
Hydraulic Installations

EXTENSIVE laboratory and testing facilities enable us to maintain a constant check on materials and workmanship. Daily experience with hundreds of pumps in our plant and the added experience gained from pumps we install on new machines, gives us first-hand knowledge indispensable to the manufacture of efficient, reliable, long-lived pumps.

For complete information get a copy of our pump catalog. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

GEARED — VANE — CENTRIFUGAL — MOTOR DRIVEN

We urge buying through the Distributor

BROWN & SHARPE

POWER BY
Red Seal
Engines
CONTINENTAL

Look for the Red Seal,
It identifies the finest
products in every field of power —
On land, at sea and in the air.

Continental Motors Corporation
MUSKEGON, MICHIGAN

Here is one example of *our*

RECONVERSION PLAN FOR MILITARY RIFLES

JOHNSON FEATHERWEIGHT SPORTER

Converted from German Mauser

Weight 7 lbs. • Overall length 43 inches

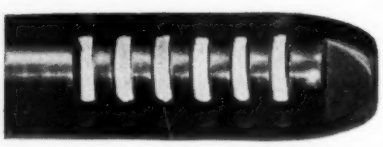
Calibers: .30-'06 • .270 Winchester
.257 Remington Roberts

This is but one example of how Johnson Automatics can rebuild *your* military rifle to a Custom Sporter. Prices range from $26 to $175 depending on the type of Sporter you want.

Write for illustrated folders giving full details and list of conversions at standardized prices.

EQUIP YOUR RIFLE WITH THE NEW

JOHNSON MUZZLE BRAKE



Price	$6.00
Installation	3.00*
Total Installed	$9.00

•Eliminates Jump • 40% Less Recoil

*Extra charge if front sight must be relocated
Factory installation is recommended
Illustrated folder on request

"Dress up"

YOUR FAVORITE GUN

Let Us

REBLUE and OVERHAUL

your gun so it will look like NEW

REBLUING—Average Price $10

OVERHAUL—Prices on request

Attractive combination Offer—if Rebluing and Overhaul work done at same time.

Write for Special Offer

JOHNSON AUTOMATICS

Founded 1920

ARMY ORDNANCE

Combined with FIREPOWER the Ordnanceman's Journal

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

FEATURES

"Eternal Vigilance" . . . . . Frontispiece
An Ordnanceman at Bikini 133
Committee for Research 134
Making the Atomic Bomb 135
A. C. KLEIN
New Aids for Night Fighting (Pictorial) 139
Samurai Swords 140
STEPHEN V. GRANCSAY
The 28th Annual Meeting, A.O.A. 143
Synthetic Toluene 144
COL. JAMES E. MCNARY
Ordnance Book Service 146
German Mass-Production Methods 147
MAJ. CHARLES E. BALLEISEN
The Silent Weapon (Pictorial) 149
Nazi Vengeance 153
E. J. TANGERMAN
Industry-Ordnance Leaders (Pictorial) 156
Recent Army Developments (Pictorial) 158
The Control of Atomic Energy 159
BERNARD M. BARUCH
Patents and National Defense 161
ROGER SHERMAN HOAR
Ordnance Roll of Honor 163
The Ordnance Orphan 165
COL. D. S. LENZNER
Wars of Atomic Destruction 168
HOFFMAN NICKERSON
Evolution of the Submachine Gun 170
GEORGE R. GANS
A Tribute to Great Americans 173
LOUIS B. SELTZER
New American Aircraft (Pictorial) 174
Month by Month 175
Atomic Explosives 177

DEPARTMENTS

New Developments . . 110
Professional Digest . . 124
Communications . . 130
Association Affairs . . 178
Let's Look Ourselves Over 181
E. B. GALLAHER
Ordnance Directory . . 182
Book Reviews 190
Index of Advertisements 199

VOL. XXXI SEPTEMBER-OCTOBER, 1946 No. 158

Copyright 1946 by the Army Ordnance Association, publisher, 705 Mills Building, Washington 6, D. C. Issued bimonthly. Single copy, 75c (by mail). Subscription rate: continental U.S. and possessions, $4.50 annually, in advance; foreign, $6.00. Entered as second-class matter, August 14, 1920, at the Post Office at Washington, D. C., under the Act of March 3, 1879. Additional second-class entry at the Post Office at Richmond, Va. Six weeks' notice before next publication date is required to effect change of address.

So many requests are received from public libraries and educational institutions for free copies of our publications—ARMY ORDNANCE, LOGISTICS, and INDUSTRIAL PREPAREDNESS BULLETIN—that we are unable to grant them all. Yet here are avenues of public information about our national defense which are of untold value. So we want to tell you about one enthusiastic member of the A.O.A. and what he is doing to help his community with little inconvenience and at only the cost of a few postage stamps.

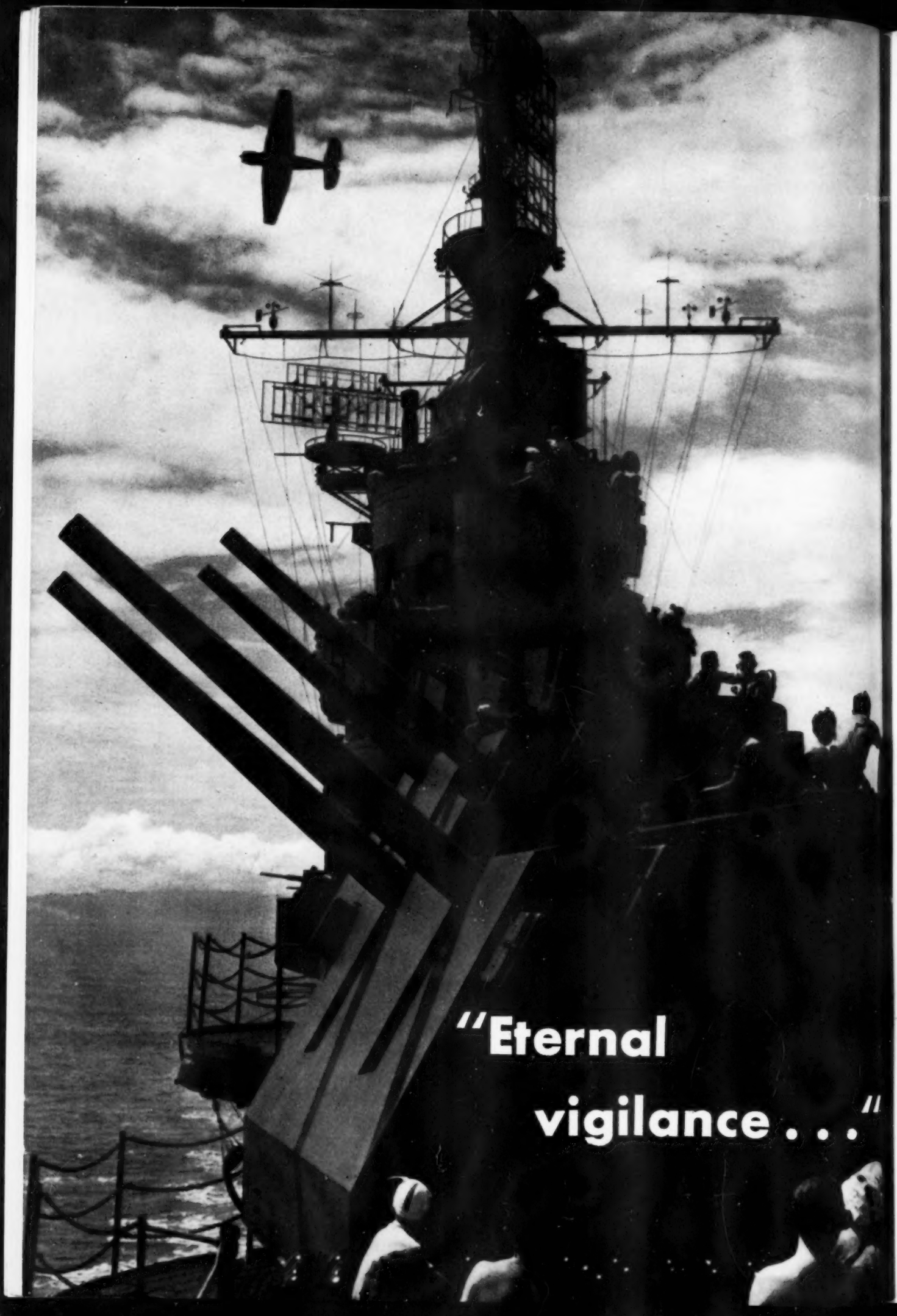
This young fellow sends his copy of ARMY ORDNANCE—after he has imbibed from the font of its wisdom and information—to the reading room of his public library. And he sends it while it is still current. His copy of LOGISTICS—after it has served his intellectual needs—he sends to the library of a college near by.

His copy of INDUSTRIAL PREPAREDNESS BULLETIN he marks in a few pertinent places and sends to the managing editor of the principal paper in his county. Already the BULLETIN has elicited sharp comment in the editorial pages of that and other newspapers.

Thus for a few pennies a month, factual information about the armament phases of our Army, Navy, and Air Forces are placed before thousands of fellow citizens who might otherwise miss them. We recommend the practice to all our members as an easy way to put important information to more general use.

That brings up the question of wider use of our associate membership among college and high-school students. More will be heard on that subject in coming months. Any way by which we can help to keep the national defense of our country in the minds and hearts of all our people—young and old—is a service which will pay the dividends of peace for generations to come.

—*The Editors*


"Eternal
vigilance . . ."

An Ordnanceman at Bikini

The Command of "Crossroads" Was in Competent Hands

Vice Adm. W. H. P. Blandy has achieved the reputation of an ordnance expert and an able leader in his 33 years as a naval officer. During World War II he served as Chief of the Navy Bureau of Ordnance and later as Commander of Group I, Amphibious Force, in the successful storming of several Pacific islands.

An honor graduate of the Naval Academy in the Class of 1913, his experience in naval ordnance has been extensive in both practical and theoretical fields. He attended several naval ordnance schools and attained an enviable record as a gunnery officer earlier in his career.

ARMY ORDNANCE is proud to dedicate this issue to Admiral Blandy for his great record, culminating in his command of the atom bomb test force.

The portrait of Admiral Blandy which appears on the front cover is the work of LeBarron Coakley, staff artist.

IT is a happy privilege for the Army Ordnance Association to pay tribute to Vice Admiral William Henry Purnell ("Spike") Blandy, U.S.N., Commander of Joint Army-Navy Task Force Number One which is currently conducting atomic bomb tests against naval vessels at Bikini Atoll in the Marshall Islands in order to gain information of value to the national defense.

Admiral Blandy is a first-rate fighting man. He was commander of an amphibious task group of the Pacific Fleet prior to and during the seizure of Peleliu and Angaur and the occupation of Ulithi Atoll. In these engagements he demonstrated exceptional ability as a planner, organizer, and skillful leader of combat personnel. Later in the war he was commander of an amphibious Support Force in preinvasion assaults of Iwo Jima, Okinawa Gunto, Nansei Shoto, and the islands of the Kerama Retto—final stepping stones to the Japanese home islands.

In these operations against a fanatical foe Admiral Blandy maintained close control of the units under his command despite incessant kamikaze attacks by Japanese aircraft and a constant rain of coast-artillery and mortar fire, successfully accomplishing each hazardous assignment and enabling our forces to launch their assaults on schedule with minimum loss to personnel or matériel.

IN addition to his combat achievements, Admiral Blandy is a former Chief of the Navy Bureau of Ordnance (1941-1943). During the time of intensive preparedness prior to our entry into the war and during the early period of global hostilities, Admiral Blandy, by keen foresight and sound analysis, successfully formulated and executed plans for the rapid expansion of all ordnance activities incident to the effective prosecution of full-scale naval warfare. Under his thorough and resourceful administration, urgent organizational problems were competently solved and vital armament requirements were adequately fulfilled with maximum efficiency and minimum delay. His forceful initiative and superior technical skill contributed materially to the progressive effectiveness of our highly coördinated war effort.

The atomic bomb is a weapon, and it was entirely appropriate that a combat commander, a resourceful logistician, and an ordnance expert should have been put in charge of Operation Crossroads. In recent months there has been a great hue and cry in various parts of the United States by a vociferous minority which either minimizes the importance of the atomic bomb as a weapon or overemphasizes it in order to exclude military-naval-air participation in its domestic use and control.

The simple fact of the matter is that the atom bomb is a weapon. For this reason it properly belongs to that technical service which has the responsibility for the design, development, manufacture, transportation, storage, and maintenance of combat weapons—namely, Ordnance.

At the moment we seem to be involved in a furious effort to tie our own hands behind our backs in the naïve assumption that all future wars are impossible and that an atomic Pearl Harbor can never happen because we do not wish to think about unpleasant catastrophies. Admiral Blandy represents the type of ordnance leadership which should be represented on all future boards or councils concerned with the domestic development and control of atomic energy. The Army Ordnance Association honored Admiral Blandy a few years ago by bestowing upon him its Gold Medal for distinguished Ordnance service.

Instead of a forced Navy-Army merger, many would be willing to permit the problem to be worked out in the normal course of events by such clear-visioned Navy representatives as Admiral Blandy and by their opposite numbers in the Army.

THE atom-bomb tests at Bikini point the way to new design changes in the ships of the fleet, new land weapons, new sea and land combat strategy, new logistical formulas, and a new sense of alertness and adequate preparedness.

We live in a world of change and we must either keep step with scientific and technological developments or go under. These inevitable changes will be made competently and successfully only if we preserve unchanged the integrity, honesty, determination, vision, and patriotism which mark such national leaders in the field of atomic energy as Admiral "Spike" Blandy.

Committee for Research

New A.O.A. Group To Foster Scientific Development

DR. C. F. KETTERING, inventor and engineer, vice-president and director of General Motors Corporation, and general manager of the General Motors Research Laboratories, has accepted the chairmanship of the Army Ordnance Association's Committee on Ordnance Research and Development. He will be assisted by the following committee members: Dr. Oliver E. Buckley, president, Bell Telephone Laboratories, New York; Dr. Rufus E. Zimmerman, vice-president in charge of research and technology, United States Steel Corporation, Pittsburgh; Dr. Ray P. Dinsmore, vice-president in charge of research and development, Goodyear Tire & Rubber Company, Akron; and Clyde Williams, director, Battelle Memorial Institute, Columbus.

C. F. Kettering

Charles Franklin Kettering was graduated from the Ohio State University and began his scientific career in the inventions department of the National Cash Register Company in Dayton. In 1909, in partnership with Col. Edward A. Deeds, he organized the Dayton Engineering Laboratories Company, later shortened to "Delco," which revolutionized the ignition system and inaugurated the general use of the self-starter for automobiles.

O. E. Buckley

In 1919 his research organization became affiliated with General Motors, and his name since then has become a byword in countless applications of research and development in the automotive industry. When the National Inventors Council was established in August 1940, Dr. Kettering was appointed chairman, and five days after Pearl Harbor he was placed in charge of the National Patent Planning Commission.

Oliver E. Buckley, president of Bell Telephone Laboratories, was born in Sloan, Iowa. He was graduated from Grinnell College, Iowa, in 1909, and in 1914 received his Ph.D. from Cornell University. He then entered the engineering department of the Western Electric Company in New York, which later was incorporated into Bell Telephone Laboratories with headquarters at New York.

R. E. Zimmerman

His technical work in the laboratories was particularly concerned with high-vacuum research, research on magnetic materials, and development of submarine telegraph cables. In 1933 he was appointed director of research, in 1936 executive vice-president, and in 1940 president of Bell Telephone Laboratories.

In World War II, in addition to heading the activities of Bell Laboratories which were almost wholly devoted to war work, he served with the Communications Division and the Guided Missiles Division of the National Defense Research Committee and as a member of the National Inventors Council.

Rufus E. Zimmerman was graduated from Franklin and Marshall College and from Massachusetts Institute of Technology where he served as an instructor in physical chemistry.

In 1933 he became vice-president of the corporation and in 1938 was appointed a director, a member of the executive committee, and vice-president in charge of research and technology. In World War I he was a consulting chemical engineer for the United States Bureau of Mines.

In World War II he was a member of the Advisory Committee of the Quartermaster General's Office and a member of the National Engineers Committee of the Engineers Joint Council and of the Policy Committee on Standardization, U. S. Department of Commerce.

Ray P. Dinsmore was graduated from Massachusetts Institute of Technology in 1914 and immediately entered the Experimental Department of the Goodyear Tire & Rubber Company. After serving in various responsible research positions with that organization he was appointed development manager in 1940 and became a vice-president in 1943. During World War II, Dr. Dinsmore served as Assistant Rubber Director, in which position he organized and directed for the Government research and development work on synthetic rubber, coördinating the activities of the Government, industry, and university laboratories.

R. P. Dinsmore

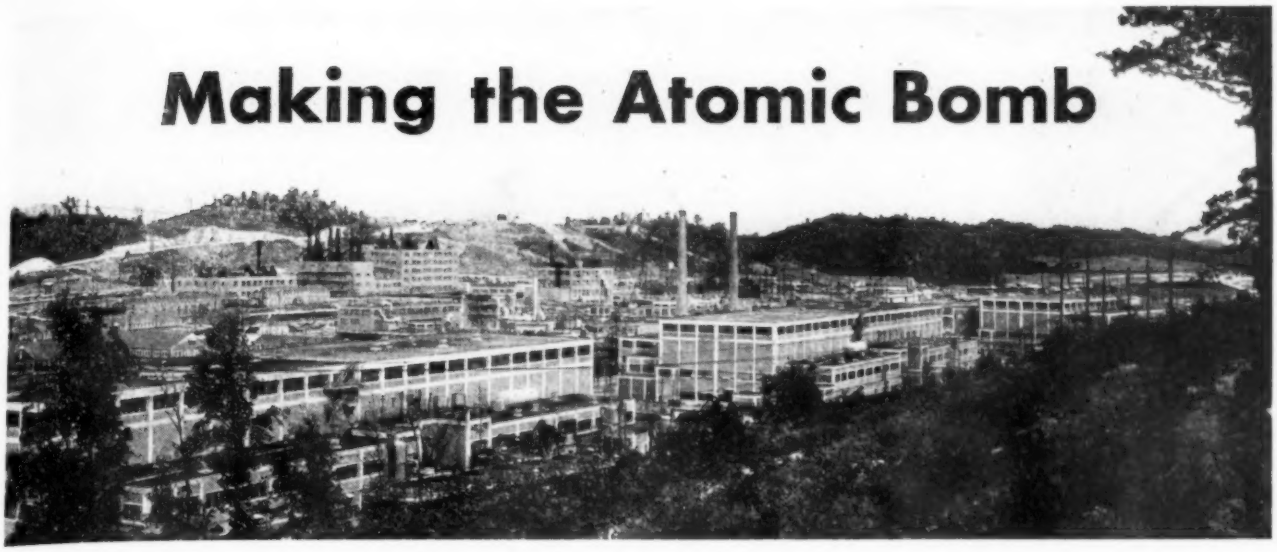
Clyde Williams was graduated from the University of Utah and served as a chemist for the United States Smelting Company, Santa Fe Copper Company, and Hooker Electrochemical Company.

In 1929 he was appointed assistant director of the newly organized Battelle Memorial Institute at Columbus and in 1934 was made director of that rapidly growing research foundation. He is a director of the Cleveland Post, Army Ordnance Association, and served as chairman of the Nickel Subcommittee, Army and Navy Munitions Board.

Clyde Williams

Later during World War II he was chief of the War Metallurgy Division of the Office of Scientific Research and Development and of the same Committee of the National Research Council.

Making the Atomic Bomb



Secrecy Marks the Manufacture of Fissionable Materials

by

A. C. Klein

Engineering Manager, Stone & Webster Engineering Corporation, Boston, Mass.

THE complete story of the achievements of the engineering profession in the design and construction of plants to separate and produce the explosive or "fissionable" material which activated the atomic bomb will probably never be told, at least in our generation.

This is due to the fact that each group of engineers who worked on the project was segregated or compartmentalized by the War Department in a manner which prevented them from obtaining any information concerning the project except that which pertained to their own particular work.

The author, however, was one of the first engineers to be associated with the project and during the B.C. (before compartmentalization) era headed an engineering group which carried on all phases of the program during the formative period of the Manhattan District. During that period, the groundwork for much of the ultimate engineering achievement was laid.

THE atomic-bomb project may be divided into the following principal parts: (1) Research and development; (2) Procurement of uranium ore and other special raw materials; (3) Design and construction of three major plants, one for the production of plutonium, and two others for the production of U-235 by the diffusion and electromagnetic processes respectively; (4) The production of fissionable materials in these plants; (5) Design and construction of the atomic bomb to utilize these materials; (6) Collateral developments including construction of heavy-water plants and townsite construction.

One of the first engineering accomplishments was to ensure to the project an adequate supply of uranium ore and to arrange for its conversion into the chemical and physical forms required by the several fissionable material processes.

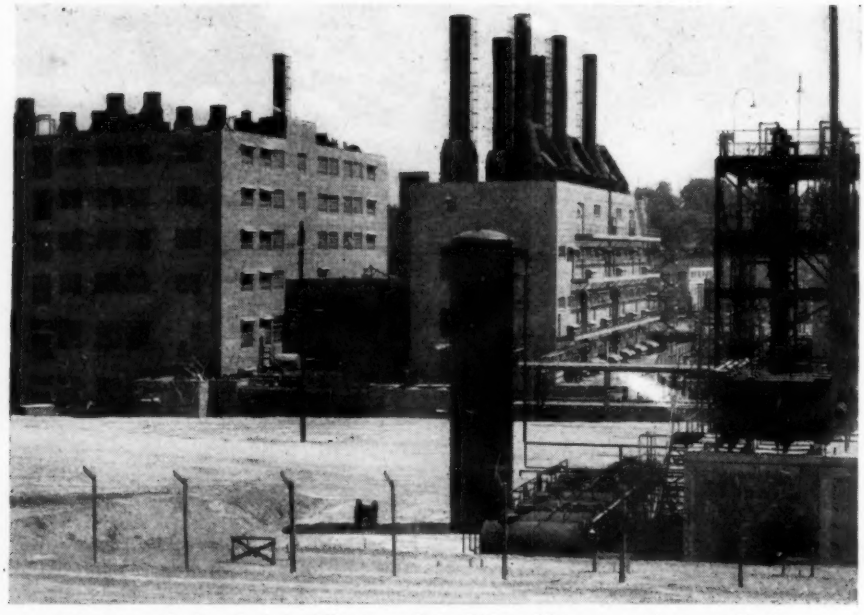
Quick action at the very outset of our connection with the project averted what might have proved a serious uranium shortage. A few days after we were engaged by the War Department we learned that the project was on the verge of losing an entire year's output of the principal available source of uranium ore. This was the output of the Eldorado mines, located in the wilderness of northern Canada, north of the Arctic Circle on the eastern shores of Great Bear Lake.

At that time access was only possible during midsummer as the lake with its connecting streams is frozen for the rest of the year. The last boat was about to leave for a trip up the Mackenzie River before it was closed to navigation. Without loss of time a telephone order was placed for a year's full output of the mines, and the Eldorado Company immediately rushed supplies, food, and miners to the boat, and the project was thereby saved a full year's ore production.

A few months later we became aware of another supply of uranium ore, which had been mined and was above ground in the wilds of the Belgian Congo. The Germans were then in North Africa and threatening Dakar. Again no time was lost. The entire supply was purchased, and it was shipped by rail to the east coast of Africa, thence by steamer around the southern tip of Africa, the southern tip of South America, and up the west coast of South America. The quantity carried by any vessel was limited, and fortunately there were no losses by submarine.

During the summer and fall of 1942, arrangements and contracts were also made with many chemical concerns throughout the country for refining uranium ore and for converting it into the physical and chemical compounds most suitable for the several processes in which it was to be used.

In preparation for the construction of fissionable-material production plants, a group of Stone & Webster Engineering



Close-up of chemical buildings at Oak Ridge. Note extensive ventilation.

Corporation engineers from Boston investigated several plant sites and in June 1942 selected the plot of land which is now known as the Clinton Engineer Works.

AS to plant design and construction, the work of Boston engineers was concentrated principally on the plant which utilizes the electromagnetic or mass spectroscope method for the separation of fissionable isotope U-235 from natural uranium. The principle of the plant is simple. A salt of uranium is vaporized and then ionized or electrified by passage through an electric arc. The atoms are then passed through an electric field having an increase in potential. By that passage they are accelerated to a speed of many thousands of miles a second.

At this high speed the atoms which consist of a mixture of uranium isotope 235 and 238 enter an intensely strong magnetic field. By the pull of the magnetic force they are curved into circular paths; the lighter 235 atoms are bent into a sharper or smaller radius or circle than the heavier 238 atoms. At the end of the semicircular path separate containers collect the heavier and lighter atoms.

The design and construction of the plant was under the direction of Stone & Webster engineers in Boston. Preliminary engineering began in June 1942. Ground was broken in February 1943, and the first unit of the plant was placed in operation in November of that year. After a short preliminary operating period it was turned over to the operators in January 1944.

In the meanwhile, authorization was given in September 1943 for a plant addition of several times the original output. The addition, which contained many engineering improvements, was completed and began operation in May 1944.

Throughout the entire design and construction period a large engineering force was maintained at Berkeley, Calif. They acted as a liaison group to coordinate the engineering work with the University of California physicists who were carrying on the research phase of the program at the same time.

Design work was also carried on during the latter half of 1942 by another group of engineers at the University of Chicago. They worked actively on the basic designs of the plutonium process and assisted the metallurgical laboratory of the university in erecting an experimental plant on the campus, at which the chain-reaction process was first demonstrated. Our engineers also selected a site a few miles west of Chicago, known as Argonne Forest, and designed and built structures for a plutonium pilot plant there. This plant was completed in December 1942 at which time all engineering work on the plutonium process was turned over to others.

After the completion of the electromagnetic plant early in 1944, it was necessary to develop means for controlling atomic energy and for releasing it as an explosive over the selected target. This work was carried on at Los Alamos, N. Mex., and has not received much publicity. The early completion of the electromagnetic plant provided the Los Alamos group with the first tangible quantities of fissionable material with which to work out their handling and detonating problems. For over a year following its completion the electromagnetic plant was the only one producing fissionable material.

The design and construction of the first catalytic heavy-water plant was another contribution of the Boston engineers. While its actual use cannot be disclosed, the production of heavy water was an important part of the project. Heavy water is water in which the hydrogen atom has a weight of two instead of its usual weight of one. In 1942, a small plant in San Francisco producing a few grams a day was the largest source of heavy water.

Arrangements were immediately made for a catalytic production-scale plant to be constructed at Trail, British Columbia, where large supplies of electromagnetic hydrogen were available. Construction of this plant was started in November 1942, and it was placed in operation in May 1943, about eight months ahead of the first plant to be completed in the United States.

Many of the most important engineering features of the electromagnetic process are still closely guarded secrets. However, a few interesting ones may now be divulged. One of them is the matter of vacuum. In the separation of light and heavy uranium atoms extremely high vacua were necessary. Failure to exhaust all the air would result in the collision of the uranium atoms with those of oxygen and hydrogen and would cause them either to lose their magnetic charges or to carom off into new paths. In either event they would not find their way into the proper collection receptacles.

In power-plant work a vacuum of one inch of mercury, or twenty-five millimeters, is extremely good practice. But in such a vacuum there would be enough air to prevent any separation of fissionable material. The vacuum required is on the order of one one-millionth of a millimeter, or twenty-five million times as great as in standard steam-turbine practice. To produce such a vacuum, enormous pumps of the dif-

During one week in September 1943 the Oak Ridge pay roll amounted to nearly $2,000,000. At the peak, over 27,000 craftsmen were employed on the project, and to obtain that number it was necessary to hire more than 130,000.

fusion type had to be designed and produced by the thousands. The engineering group at Berkeley prepared these designs in coöperation with University of California physicists.

Another feature was the use of silver instead of copper for electrical conductors. In 1942 and 1943 copper was urgently needed for ammunition production. In order not to encroach on the supply for that purpose, the engineers substituted silver for it. In all, 14,000 tons of silver having a value of about $400,000,000 were withdrawn from Treasury stocks, processed in copper rolling mills, and silver-soldered into conductors of the requisite length. It is interesting to note that the value of the silver used was approximately equal to the entire construction cost of the electromagnetic plant and of the town of Oak Ridge.

ANOTHER important engineering development was the design of the production magnets. These huge structures, 250 feet long, were constructed of thousands of tons of steel of the highest possible permeability. They were one hundred times as large as the largest magnet which preceded them. Naturally, tremendously strong magnetic fields were set up around each magnet. The pull on an ordinary piece of pipe, wrench, or hammer was so great that it would be wrenched from a workman's hands.

One of the most important specifications for the plant was that it must operate continuously 24 hours a day, 365 days a year. This involved the introduction of many engineering developments which did not have to be considered in the research work. The magnets generated tremendous quantities of heat, and various parts had to be cooled by circulating streams of oil, air, and water.

Change-over operations had to be performed in a minimum of time, requiring the development of quickly detachable piping and electrical connections. The slightest leak, even of microscopic size, was sufficient to interrupt the process until repaired, and it therefore became necessary to develop special equipment to detect any such leaks.

One important adjunct to the plant is the extensive chemical area. This is required because not all feed material is separated into its two component isotopes during process operations. Much of it goes astray and has to be recovered from the walls of the containing vessels and from parts of the operating mechanism. The high speed of the atoms causes them to impact and to combine physically or chemically with the metals comprising the separating equipment.

Therefore all parts of the operating mechanism must be removed periodically, cleaned, and washed with steam, acid, and by electric stripping. The result is an acid solution of uranium compounds containing impurities such as iron, nickel, copper, and other metals. The separation of the uranium from the solution and from other metals is necessary before it can be recycled or passed along to a final concentration stage. The chemical plant must also convert the uranium into the chemical compound most suitable for process feed and must refine it to the high degree of purity, dryness, and pulverization which has been found necessary.

The construction of the chemical plant was particularly difficult because uranium chemistry was practically unknown, and the processes therefore had to be developed during the engineering period. Almost all the equipment had to be especially designed with only test-tube experiments as a guide. One notable achievement of which it is hoped details will shortly be available was the extensive use of glass piping for conveying solutions.

An entirely new technique of field cutting and welding of glass pipe was developed, as a result of which it was possible to duplicate in glass all the feats of steel-pipe welding and even to add to them one trick not possible with steel.

Another very important feature of the chemical plant was provision for salvaging every particle of material whose U-235 content had been enriched.

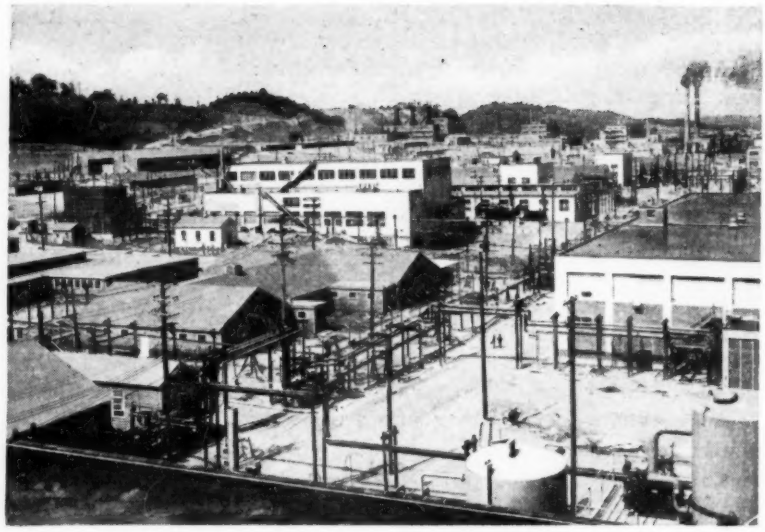
These precautions were absolutely necessary to keep the plant capacity up to rating. Some of them are interesting. In the cleaning process, drops of uranium solution splash onto the operator's clothing and are absorbed by them. This material is recovered by washing the uniforms in small laundries in the individual buildings, saving the wash water, and extracting its uranium content. A large incinerator building is also provided in which discarded uniforms and shoes and all other combustible objects are burned. The incinerator ash is then dissolved in acid and treated for uranium recovery.

It will be apparent that the salvage operations are very important and extensive. Probably the most extreme measure is the treatment of ventilating air in the chemical area for the recovery of uranium-bearing dust which might

Some of the 119 buildings which comprise the electromagnetic plant.

otherwise be carried out of the building and lost in the atmosphere.

The time schedule of plant construction—a period of nine months from February to November 1942—was so short that it permitted the development of only a minimum amount of new equipment, but even that minimum was tremendous. However, the utmost efforts were made to adapt standard equipment available from manufacturers' production lines rather than to design special equipment.



Panorama of electromagnetic plant showing the chemistry area in the rear center and the process buildings, right background.

Secrecy regulations were one of the most severe handicaps with which we had to contend. Only a few engineers knew the object of their work, and the rest labored in all degrees of darkness from dense twilight to Stygian blackness. A few may have drawn their own deductions but their guesses were far from the truth.

SECRECY began with the setting up of an engineering organization completely divorced from all our other work. Only American citizens were permitted to work on the project and then only after severe scrutiny of their records by the Intelligence Division of the War Department.

In the entire Manhattan project the word uranium was never used; its code name was tubealloy. The numerals 235 and 238 were likewise taboo. Initially, these components were designated as magnesium and aluminum, but it was soon decided these were too revealing and, thereafter, they simply bore the code letters X and Y.

No parts of the critical apparatus were ever referred to by their proper names but rather by code letters which were assigned to them. Likewise, no building was ever referred to by name but rather by a code number.

The transmittal of information by drawings was extremely difficult. It was necessary that all possible revealing information or words be omitted. Where drawings did contain revealing information they were stamped "Confidential" or "Secret" and kept in vaults to which only confidential employees had access. The information they contained could only be transmitted to workmen by piecemeal sketches and notes made within the restricted area.

All manufacturers working on important equipment complied with the same strict regulations, not only in their engineering and drafting divisions but also in parts of their shops which produced finished or semifinished materials. These were kept under constant guard, and operations in them were carried on only by confidential employees of unquestioned loyalty and American citizenship. Burdensome as these restrictions were, it is to the highest credit of the tens of thousands who worked on the project that they were cheerfully accepted. The success of the project and the gratitude of the Nation go to those whose skill and loyalty permitted them to work so effectively with such limited information.

In the execution of its contract with the Manhattan District, Stone & Webster Engineering Corporation expended about $400,000,000, principally for the construction of the electromagnetic plant and for the town of Oak Ridge—$275,000,000 of this being spent for materials and equipment. At the peak of the project, procurement was at the rate of about $2,000,000 a week. This tremendous procurement program was all the more difficult because the deliveries required were almost impossible. Only by the exercise of the greatest ingenuity was it possible to achieve the required result without dislocating the entire priority structure of the country.

At the plant site the job pay roll amounted to over $106,000,000. During one week in September 1943 the pay roll amounted to nearly $2,000,000, and for over a year it averaged over $1,000,000 a week. At the peak, over 27,000 craftsmen were employed on the project, and to obtain that number more than 130,000 were hired.

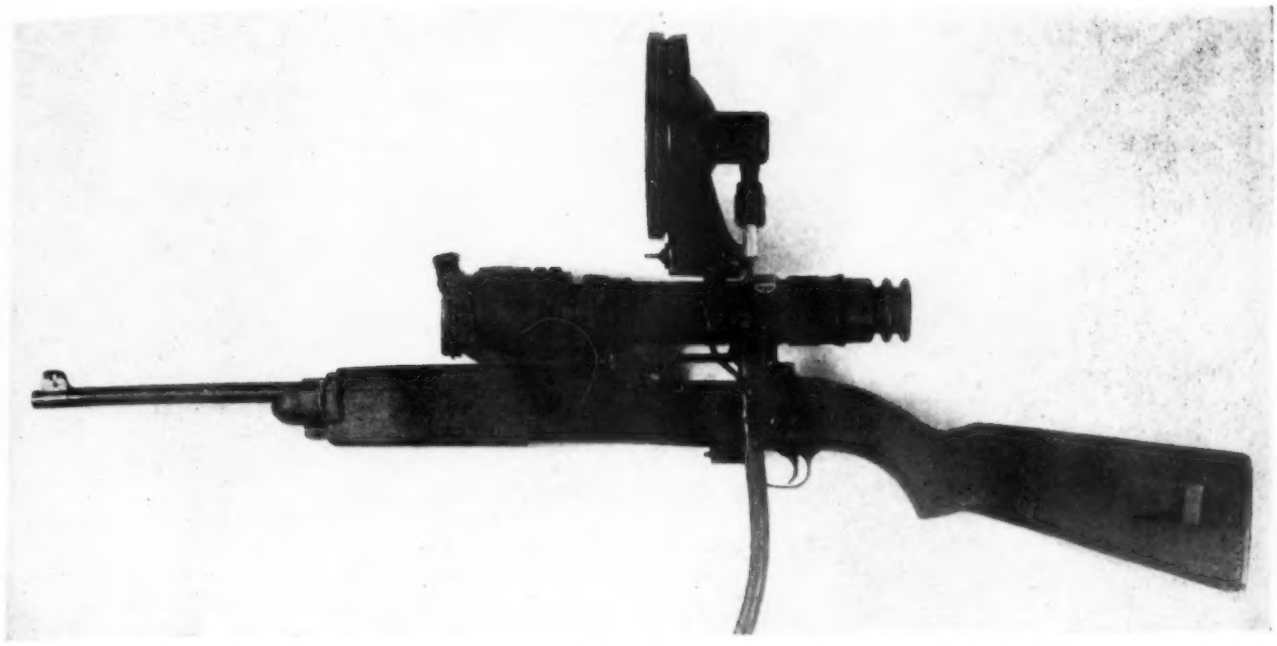
From a military standpoint, the production of atomic bombs is possible within a period of from five to ten years by a large number of foreign nations. In the first place, there is a plentiful supply of uranium ore in almost every part of the world. Uranium is more abundant than zinc and is nearly as abundant as copper. Raw materials for the production of other atomic-bomb components are also plentiful.

All the nations of the world have access to the scientific research data underlying the production of fissionable materials. In addition, those nations which coöperated with us in the production of the bomb assembly have also had access to the production methods and engineering designs which we have developed during the past four years. These could, with the same application of engineering energy, probably produce a bomb within five years while other nations could do so in about ten years.

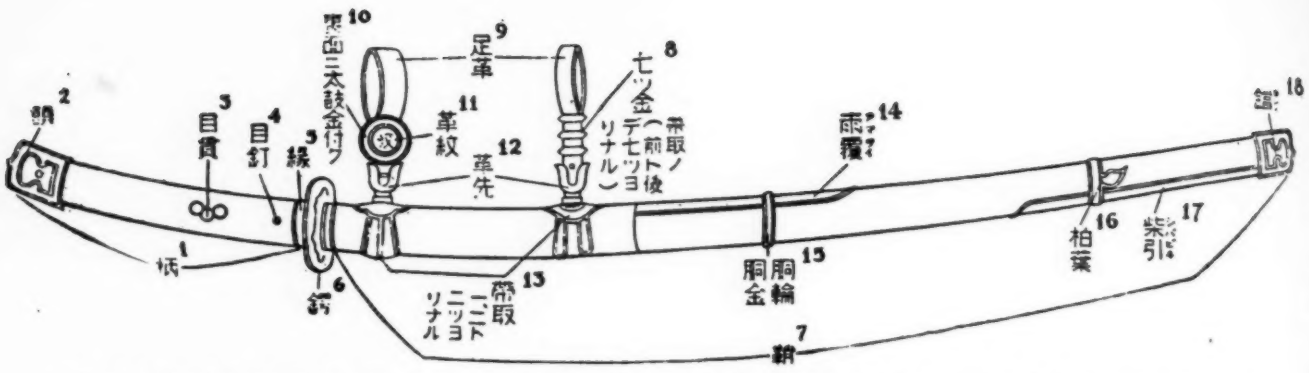
THE first atomic-bomb plants may be expected to be huge structures weighing many hundreds of tons and to generate electrical energy in hundreds of thousands of kilowatts. They will be located in isolated areas but reasonably adjacent to large electrical transmission networks which can absorb their energy output on practically a one hundred per cent load factor basis. From the operation of these huge plants experience will be gained that will permit economy of operation, so that smaller-sized plants will become practical.

However, only some revolutionary advance in the scientific principles underlying the art of fissionable materials production and use will permit the employment of atomic energy in such small units as the automobile.

New Aids for Night Fighting



The "sniperscope" and its infrared spotlight, shown above mounted on a caliber .30 carbine, enabled Army marksmen to see and dispatch enemy personnel on the darkest nights while remaining unseen themselves. The "snooperscope" below, weighs 6 pounds and is fitted to a special helmet. First used in the Pacific in 1944, it did much to check enemy night infiltrations.



Drawing showing mountings of a slung sword (*tachi*). These include the hilt and its apical and base caps, rivet, and ornament which originally concealed the rivet; the sword guard; the scabbard and its ferrules; chape and fittings.

Samurai Swords

Japanese Metal Workers Used Unusual Techniques in Making These Weapons

by

Stephen V. Grancsay

To the Japanese, a sword was an object of spiritual as well as material significance, and was revered and deified as an emblem of power and authority.

THE worship of the sword prevailed in the East as well as in the West. In both, the inspiration sprang from the same source—the wish to interest Divinity in the cause for which the weapon was wielded. In Japan, veneration of the sword paralleled and perhaps surpassed the sword-sentiment of the Middle Ages in Europe, where its touch upon the shoulder conferred the knighthood which soldiers longed to win.

Let there be no mistake: Every Japanese knows that the sword is not a mere weapon. He has always been taught that it is an object of spiritual as well as of material significance. It was inevitable that a race of warriors who lived by the sword should revere and deify the emblem of their power. Thus a sword, a mirror, and a curved gem constitute the three sacred treasures which symbolize the Emperor's divinity. The mirror symbolizes wisdom, the gem benevolence, and the sword justice and courage. One who carried with him the wisdom of the mirror, the benevolence of the gem, and the justice and courage of the sword was a true samurai.

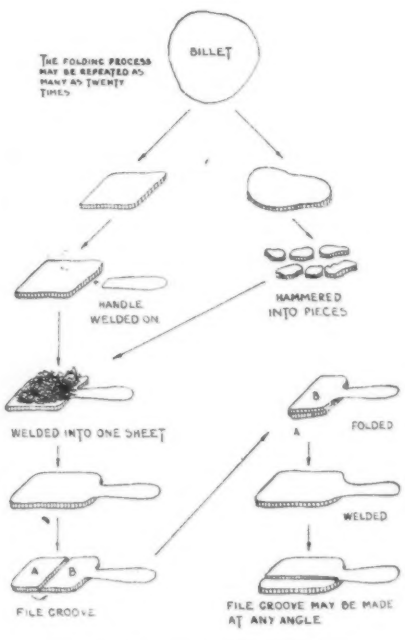
THE samurai or sword-wearing class were the rulers until less than a year ago when the American troops first occupied Japan. With the radical changes that are taking place in Japan daily it is safe to assume that the reverence for the samurai, or military aristocrat, as well as for the sword, is diminishing. Neither the samurai nor the sword is any longer the source of authority.

The early history of the Japanese sword carries us back into legendary times. The first god swordsmith was Amenohitotsu-no-kami, the artist of "Kusanagi no tsurugi" (grass-mowing sword) which is one of the three divine treasures of Japan. Because a sword is considered to possess the divine soul of the samurai, many of the shrines throughout Japan have had those swords dedicated which were associated with divine heroes. Hence many of the oldest and most remarkable swords are ex-votos in the temples scattered widely throughout Japan.

One of these temple swords, made as recently as 1942 at Muroran, Hokkaido, by Toshihide Horii, was turned in to 77th Division during its occupation of Hokkaido. It was presented to the U. S. Military Academy Museum at West Point by Maj. Gen. A. D. Bruce on behalf of the 77th Division.

It is less than a century (1854) since Commodore Perry opened Japan to the West, and it was the free intercourse of Japan with the rest of the world that broke down the ancient feudal system in which, from birth to death, everything was done by ceremony. The etiquette of wearing the sword was formal and explicit, and every Japanese of rank made a careful study of it. There were those appropriate for war and others which were only to be worn on ceremonial parades and at courtly functions.

The Japanese have always been a



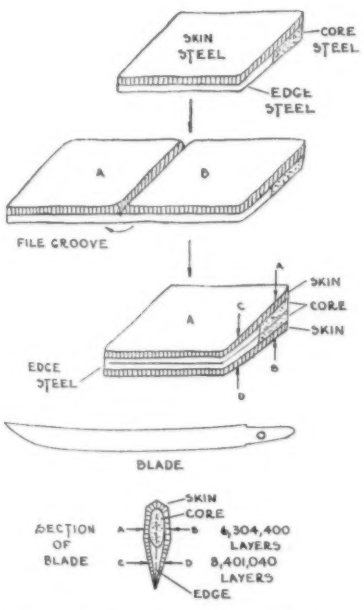
PROCESS OF WELDING THE FOLDED SHEET

Mr. Grancsay is curator of Arms and Armor, Metropolitan Museum of Art, New York City. This article, with its accompanying illustrations, was originally published in the February 1946 issue of the *American Collector* and has been rewritten especially for ARMY ORDNANCE.

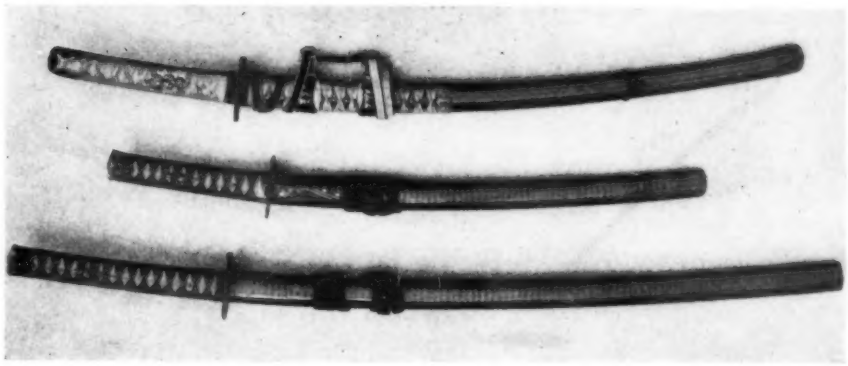
martial nation and therefore valued their weapons greatly. Of these the sword was considered the noblest of all, and the blade is considered the noblest and most precious part of the sword. The samurai cannot be disassociated from his sword. The privilege and etiquette of wearing it, the deeds wrought with it, the superstitions and lore of centuries connected with it, the relation between its æsthetics and its practicality —these are some of the reasons why his sword ranks above all his possessions in a samurai's esteem.

The reason for exhibiting blades in a museum of art is because they have considerable æsthetic merit. The creative ability of certain Japanese bladesmiths is compared by students to that of the leading literary men of China. There are extant long lists of celebrated bladesmiths with biographies, and there is a great deal of legend and anecdote associated with them.

Both in the Museum of Fine Arts in Boston and in the Metropolitan Museum of Art in New York are several hundred swords, including many examples of the three main types; that is, *tachi* (slung swords) which were worn at court or on ceremonial occasions and were suspended from the belt by two slings and hung edge downward (see top of pp. 140 and 141), and the pair of swords (*daisho*), the *katana* and *wakizashi*, the long and the short sword, which were thrust through the sash and carried edge upwards (see top of this page.



DISPOSITION OF THREE TYPES OF STEEL WHICH ARE FORGED INTO BLADE



The slung sword (top) was originally used in war and later for ceremony. The short (center) and long (bottom) swords indicated the military caste.

Until the year 1876, when the open wearing of swords in Japan except by military officers and court officials was forbidden by imperial decree, the wearing of two swords was the highest privilege of the samurai. One of these swords, the long or fighting sword (*katana*) was for enemies; the other, shorter *wakizashi* was for the wearer's own body in case of defeat or when one wished to sacrifice one's life for a noble cause.

The particular virtue of a Japanese blade is that it has an extremely hard and keen edge while the body of the blade is relatively soft. Blades were made of steel of sterling quality, and every one was forged upon the anvil—beaten out of billets with skill and judgment by an artist.

In every case the blade was laminated an astonishing number of times, but the forging was accomplished with extraordinary skill.

Many different methods were employed in building up the billet from which the blade was finally forged, and the preparation of the constituent pieces is in itself a fine art. In one of the methods which was in widespread use, plates of iron and steel were welded together. The resulting single plate was notched across the middle, folded on itself, welded together, and drawn out under the hammer to its original size. This process was repeated from twelve to eighteen times, resulting in a billet containing many thousands of layers of alternate iron and steel. In some cases, several billets were prepared, welded together, folded, and hammered to the desired size.

Another type of constituent piece is made of a sheet of steel to which fragments or needles of similar but harder steel are welded, a process which resulted in producing the isotropic structure of the steel (see bottom of p. 140). (The harder steel is made by throwing a sheet of steel into water while hot, then hammering it to pieces.) As many as 15 lumps of steel averaging 1½ pounds apiece may be required to make a blade weighing 1½ to 2 pounds when finished. It is the retention of good and elimination of bad steel which is the reason that so much steel is necessary for making a good blade.

EACH of the small bits of steel is inspected before being used. If its edge of fracture is dense, granular, and homogeneous in structure and of a dull gray color, the steel is regarded as good. If, on the other hand, the edge of fracture is cracked, glistening, and of uneven color, the bit of steel is rejected.

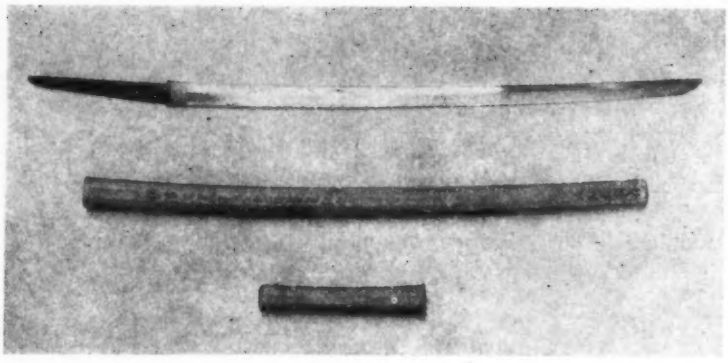
Another kind of compound blade was built of steel only but of three varieties carefully selected so that each should possess the physical properties required in that part of the blade for which it was to be used. Thus the bar from which the blade had to be forged was built up and welded in such a way that one kind of steel formed the inner body or core; another, the sides (skin or cover steel); and a third, the edge.

The aim was to give the blade a combined structure of properly distributed hard and soft steel. For example, the edge steel (*Hagane*) is theoretically folded 20 times and consists of 1,048,576 layers (2^{20}); the core steel is made by folding eight times, giving 256 layers (2^8).

The making of the skin steel (*Kawagane*) is more complicated. Three square sheets, one folded 16 times, the second folded 6 times, and the third folded 7 times, ($2^{16} = 65{,}536$; $2^6 = 64$; $2^7 = 128$) are hammered into a single rectangular sheet of 65,728 layers; the next step is to cut the plate

in three and place one over the other; *i.e.*, 65,728 × 3 = 197,184 layers. These are finally bent 4 times; *i.e.*, 197,184 × 2^4 = 3,151,944 layers.

These three types of steel are finally welded together. Square pieces of core and edge steel are placed side by side, and a sheet of skin steel of the size of the core and edge steel together is placed over them. This is hammered into a rectangular piece, cut in two, and turned over so that the skin steel comes on the surface. This is hammered down into a blade—over eight million layers having been welded and stretched out at the edge (see bottom of p. 141).



The blade (top) is protected with a wooden sheath (center) and a hilt.

THE edge and point are the critical areas. After the blade is forged, it is given a special heat treatment increasing the carbon and silicon content at the edge, which thereby becomes much harder than the rest of the blade. The extent of this hardening, and of the color change which accompanies it, can be exactly controlled. The tempering is usually accomplished during the eighth or the second month, for at these times of the year the water is considered most suitable for hardening the edge. For this reason, when a blade is dated and the month is also given, it is usually the eighth or the second.

The pattern produced in the steel by the laminae of which it is built, and by the change of color at the edge, is called *yakiba;* at the point, *boshi*. These are readily distinguished by their lighter, whitish color from the darker, bluish color of the rest of the blade. The outline of the *yakiba* formed one of the distinguishing characteristics of different smiths and schools of blade makers. There are thirty-two recognized principal classes of outline, with several subdivisions. A narrow, straight, hardened edge or a simple, irregular one is in general preferred, for a broad *yakiba* implies that a large breadth of the blade is brittle.

From the *yakiba* one may judge the quality of a blade and, indirectly, the authenticity of a signature on the tang, or determine its age and maker if not signed and dated.

The sharpness of a blade depends upon the technique of tempering. However, in addition to the quality of the tempering, the position of the center of gravity of a blade is an important factor in determining its cutting power. The story of Saladin's feat of cutting a down cushion in two with his scintillant blade might well be credited by those acquainted with the keenness of the Japanese sword.

The tang (*nakago*) ends in one of three forms—square, round, pointed—or in an intermediate form. It is left rough, usually showing the marks of the smith's file, called the *yasurime,* in a characteristic pattern. The inscriptions on tangs usually include the blade-smith's name, the province where made, and the date. The tang provides an important clue for the authenticity of blades; from it may be determined the quality of the blade, while its file marks assist in distinguishing artists and schools.

The tang is often altered, but the characteristics of both original and altered tangs are known. It is sometimes cut off and the lower part of the blade filed into a new tang. Such an alteration was accomplished for one of several reasons: (1) from a superstitious point of view to change the aspect of a sword; (2) to alter a shinto to look like koto; (3) during the Genki (1570-1572) and Tensho (1572-1591) eras, the method of fighting changed, and long swords became inconvenient, so they were shortened.

After the tempering, the finishing steps are taken. The blade is carefully cleaned and roughly ground. The smith then judges whether the blade is satisfactory, especially whether the hardening is right and whether there are imperfections in the metal. Sometimes to lighten the blade, grooves or blood drains exactly semicircular in section are cut. Then the hole in the tang is drilled for the peg that holds it to the hilt.

The only decoration found on blades is that of the chisel, which is used to produce grooves, inscriptions, sacred letters (*bonji*) as a charm, or pictorial carvings representing dragons, gods, flower sprigs, etc. Such carving sometimes serves to conceal blemishes in the blade, hence it is distasteful to some connoisseurs. The blade is finally ground, polished, and mounted. It is estimated that it required sixty days working from early dawn to late at night to finish a blade, and the energies of gods and men were combined.

The Japanese swords are divided into two great classes, called koto and shinto, meaning respectively old sword and new sword. The koto are those made prior to the eighth year of Keicho, or 1603 A.D., and the shinto those made after this date. The superior blades are usually found among the koto which have ordinarily a pronounced curve, but most shinto are curved in a vulgar taste, or almost straight.

THE care of the blade is of the utmost importance. When the sword is in use, the blade should be dusted with a rice powder dabber (*uchiko*) twice a month in summer and once a month in winter, being finally wiped with a mulberry-fiber handkerchief or soft paper (*hosho-gami*). Chamois might also be used. In the rainy season the blade should as far as possible not be drawn. It should be kept in good condition and free from rust by a thin application of pure oil of cloves (*choji-abura*), or camellia-seed oil, (*tsubaki-abura*), the superfluous oil being wiped away. If the weapon is put away, a position free as far as possible from damp should be chosen, and it should be well wrapped.

I have before me an illustrated newspaper account of a Japanese swordsmith in Kyoto who cleans, repairs, and evaluates swords for American soldiers. Many of these blades will undoubtedly be of excellent quality, but it is unlikely that many masterpieces have been acquired by Americans, for bona fide civilians have been permitted to retain swords that are works of art. Nevertheless, the soldier should be certain that there is no "change of blades" during the reconditioning process.

The 28th Annual Meeting, A.O.A.

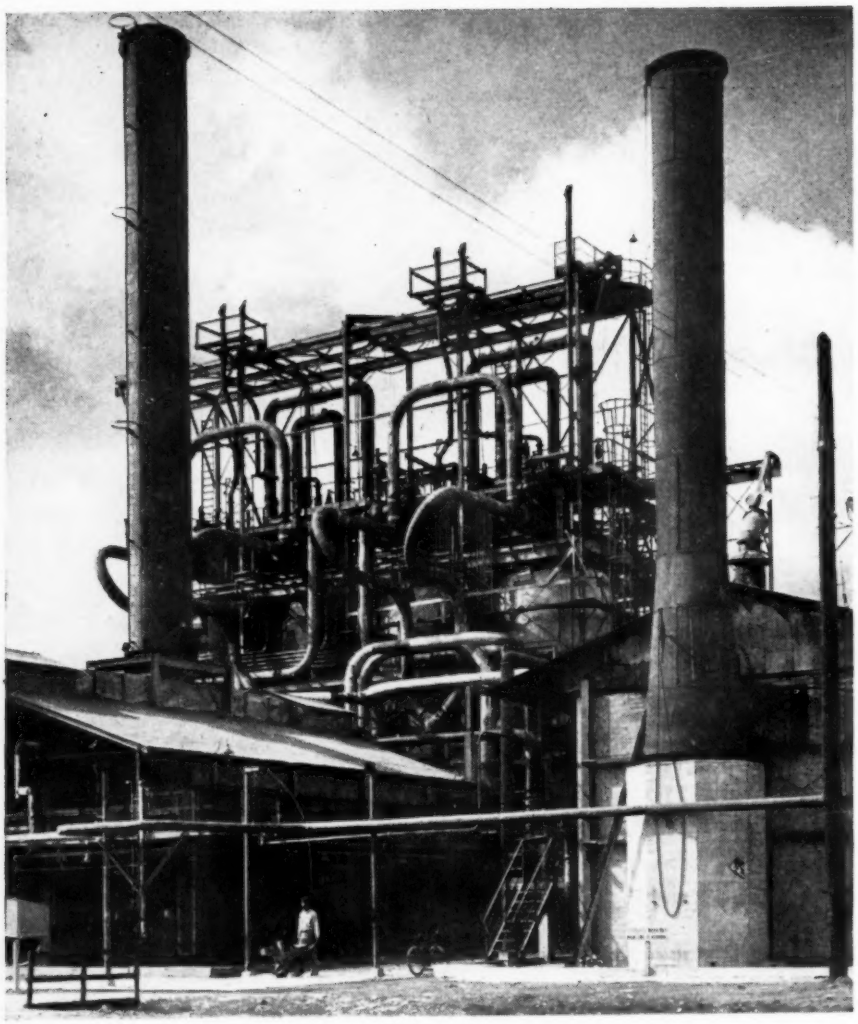
The Ordnance Cohorts Reactivate Ordnance Day at Aberdeen

ALL members of the Army Ordnance Association are invited to the Twenty-eighth Annual Meeting to be held at the Aberdeen Proving Ground, Md., on Thursday, October 3, 1946.

¶ The Chief of Ordnance, Maj. Gen. Everett S. Hughes, has arranged a program of current tests demonstrating the technological problems which face the Ordnance Department in the design, production, maintenance, and supply of weapons in the atomic age. Members will obtain first-hand information on the problems of industrial preparedness as they relate to modern fighting equipment for our armed forces.

¶ Admission to the meeting will be restricted to members of the Army Ordnance Association exclusively. The program of tests will begin at 10 A.M. and conclude at 4 P.M. Box luncheons will be served at noon for which advance reservation must be made.

¶ This will be the first opportunity for Ordnancemen and women to assemble since the termination of hostilities. It will provide them with current technical information regarding ordnance problems of our fighting forces in the solution of which they can continue to be of inestimable help for the national defense of the United States. Personal invitations and detailed information have been mailed directly to all members.



Synthetic Toluene

New Production Methods Solved a Serious Explosives Supply Problem

by

Col. James E. McNary

THE story told here by Colonel McNary emphasizes the advantages of close coöperation between industry and the military in time of peace as well as in war. This narrative describes the principal steps taken in an important field long before the national emergency of 1939-1945. It demonstrates that industrial-mobilization planning as well as Ordnance research and development require serious attention in the days of peace if we are to be prepared in time of war.

The editors would like to supplement what Colonel McNary has written by including in this record the names of some of the Ordnance personnel who played an important part in the adaptation of the oil-hydrogenation process long before it was used quantitively in World War II. Among those who took a leading part in this historic project are (with their military rank of that time):

Lieut. Col. Charles F. Mettler, executive officer, New York Ordnance District, who started the ball rolling in January 1933; Lieut. Col. H. K. Rutherford, executive officer, New York Ordnance District, who assisted in carrying the project forward during 1934 and 1935; Col. L. B. Moody, Maj. J. K. Clement, Maj. J. P. Harris, and Dr. G. C. Hale, all of Picatinny Arsenal, who directed the original tests in 1935 and 1936. And finally the author, Col. James E. McNary, whose modesty when preparing this manuscript prevented him from including his own efforts and those of his company throughout the entire period.

To them all, to the officials of the Humble Oil & Refining Company, Baytown, Tex., and to the countless others who helped, our country owes a debt of gratitude for vision, industry, and performance. Toluene of high quality and in astronomic quantity was no problem in World War II—because of sound steps taken years before.—THE EDITORS.

TNT was the major high explosive in World War II, just as it was in the first World War. The wide use of this explosive is the result of several characteristics which make it unique. When detonated with mercury fulminate, TNT produces great brisance or shattering power. Without the fulminate, the explosive can be ignited and will burn quietly. This provides a safety factor which makes TNT easy to handle in loading shells, mines, and similar weapons. In addition, TNT is not too difficult to make and is relatively inexpensive.

At the beginning of World War II, the United Nations were faced with the problem of making TNT in the greatly increased quantities demanded by the magnitude of the war and especially by the expansion of aërial bombing. Making enough TNT meant producing toluene, the principal raw material, in huge amounts.

Toluene, a hydrocarbon chemical, looks like water but smells like paint remover and burns like gasoline. When toluene is nitrated—that is, mixed with nitric and sulfuric acids—the end product is trinitrotoluene or TNT. In peacetime, toluene is a valuable solvent in the application of paints and varnishes, inks, dyes, and other coatings. Although toluene was as essential to victory as our tanks, planes, and ships, little publicity has been given to the tremendous difficulties that were encountered and overcome in originating and perfecting methods for its mass production.

During World War I, toluene was obtained from coal tar. About half a gallon of the chemical is derived as a by-product in the coking of a ton of coal. Prior to that war, toluene production was less than 1,000,000 gallons yearly, for most coke ovens were not operated so as to recover the toluene they produced. Skyrocketing prices, however, stimulated the recovery of more toluene. The following table indicates trends in production and prices during the period:

Year	*Toluene Produced (gallons)*	*Price per Gallon*
1914	?	$0.33
1915	623,000	2.45
1916	3,940,000	2.85
1917	7,395,000	1.37
1918	8,860,000	1.43

There was not enough toluene during 1914-1918, but the total amount of product made then was insignificant compared to the requirements indicated at the beginning of World War II.

Certain petroleum fractions contain small percentages of toluene, but no means of obtaining large quantities of toluene from petroleum were available until a process for synthesizing it was developed just prior to World War II.

The process for making synthetic toluene from petroleum was largely responsible for the fact that, by the end of the recent war, the Nation was producing nearly as much toluene in one month as was produced during the entire period of World War I. And synthetic toluene cost only about thirty cents a gallon!

BEHIND this accomplishment lie many stories of successes and failures, perhaps less dramatic than engagements on the military front but none the less having an important bearing on the outcome of the war. Many chemists, engineers, and petroleum technologists gave unstintingly of their time and effort to bring this phase of the war to its fullest success. An example of what was accomplished can be found in the Baytown Ordnance Works, operated by Humble Oil & Refining Company an affiliate of Standard Oil Company of New Jersey. Careful selection of feed stock, "bottleneck removal," and processing improvements enabled the production of this plant to reach more than 200,000 gallons a day, or roughly, 250 per cent of its rated capacity.

The development of this new process dates back to September 27, 1927, when Jersey Standard bought from I. G. Farbenindustrie of Germany the American rights to their oil-hydrogenation process. Standard Oil Development Company, Standard's research organization, began to study hydrogenation, although no thought was given to toluene synthesis at the time.

The process for making synthetic toluene from petroleum was largely responsible for the fact that, by the end of World War II the Nation was producing nearly as much toluene in one month as was produced during the entire period of World War I.

By May 1933, however, it had been found that toluene was a possible by-product of the hydrogenation process, and a gallon of low-grade material was produced in the laboratory.

A year of research followed. Samples of synthetic toluene tested at Picatinny Arsenal produced TNT of normal characteristics but not up to Government specifications. Research continued until 1936, when a sample of synthetic toluene was successfully made into TNT which met all requirements. The outcome of this development, known only to the Army Ordnance Department and the Standard Oil Development Company, remained a military secret until 1940.

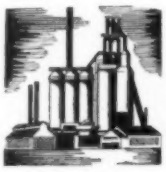
With the fall of Poland, the need for a large supply of toluene was more apparent than ever. A major problem was in purifying the chemical to the high degree required for nitration into satisfactory TNT. Within a few months, Standard Oil Development Company had developed a new and satisfactory means of purifying the synthetic product. The Army Ordnance Department ordered two tank cars of toluene for nitration tests, and all the necessary facilities of three different refineries separated by over 1,500 miles were placed at the disposal of the urgent project.

One hundred 10,000-gallon tank cars of a special fraction of crude oil were prepared by the Humble Company in Baytown, Tex. Tankers carried the material to Bayway, N. J., where it was hydroformed and then concentrated by fractionation into twenty two tank cars. This was shipped back to Baytown for preliminary purification and from there to Baton Rouge, La., for further purifying. At Baton Rouge, the original one hundred tank cars emerged as two tank cars of nitration-grade toluene.

The 2-tank-car shipment was prepared in record time. Tests by Ordnance showed it to be entirely satisfactory, and the Government financed the construction of a commercial toluene plant to be located at Baytown, Tex., adjacent to the Humble refinery.

This was in the fall of 1940. Construction was speeded by every means, and in September 1941 the first synthetic toluene was produced. Less than three months later Pearl Harbor stunned the country. During the ensuing critical year, when the bottom of the toluene barrel was scraped regularly, the Baytown Ordnance Works produced more than half of the toluene used in this country for the manufacture of high explosives for shells, bombs, torpedoes, and similar weapons. It is difficult to predict what might have happened had this supply of toluene not been available.

Although the Baytown Ordnance Works alone was producing toluene at more than twice the maximum rate reached by the entire coal-tar industry in World War I, it was apparent soon after Pearl Harbor that additional supplies would be needed to wage war on the scale planned. Accordingly, the Jersey Standard affiliates made their toluene process available to the United States Government.



After the problem of producing synthetic toluene had been surmounted, it was necessary to develop special purification methods, since the synthetic product is much more difficult to purify than is the coal-tar derivative. Accordingly, three different purification procedures were developed by Standard Oil Development Company, Shell Development Company, and the Union Oil Company of California.

A major factor in the successful solution of the over-all toluene problem was the Toluene Technical Committee. This committee, composed of representatives of the petroleum industry interested in toluene manufacture, was conceived by the Army Ordnance Department early in the war to facilitate exchange of pertinent technical information.

ANNOUNCING!

THE ORDNANCE BOOK SERVICE

Another Exclusive Service for A.O.A. Members

The Army Ordnance Association is happy to announce the establishment of the Ordnance Book Service. Members may now obtain any book in print through Association headquarters at a saving over the standard retail price. In addition, an Ordnance Book of the Month will be featured regularly at a substantial discount, and members will be kept constantly informed of worth-while new books, both military and nonmilitary.

Use the Ordnance Book Service. It is for members exclusively. Through it the Association will help you to help keep America strong. The Ordnance Book Service offers members the following advantages:

1. **Savings:** (a) A saving of twenty per cent on the new book by Lieut. Gen. L. H. Campbell, Jr., "The Industry-Ordnance Team." (b) A saving of fifteen per cent on the Ordnance Book of the Month to be announced regularly in ARMY ORDNANCE, LOGISTICS, and INDUSTRIAL PREPAREDNESS BULLETIN. (c) A saving of up to fifteen per cent on any book in print.

2. **Promptness:** All book orders will be processed and mailed within twenty-four hours of receipt.

3. **Convenience:** Books will be delivered postpaid to your door. Now you can order all your books from one place—in one letter.

4. **Service:** The Ordnance Book Service will keep Association members continually posted on the latest worth-while books—military and nonmilitary, fiction and nonfiction. Write us to help you solve any book problems you may have.

5. **Exclusive:** The Ordnance Book Service is an exclusive privilege of members of the Army Ordnance Association. Take advantage of your membership to make full use of its benefits.

Address all orders and inquiries to the Ordnance Book Service

ARMY ORDNANCE ASSOCIATION

705 Mills Building Washington 6, D. C.

German Mass Production Methods

The Use of Stamped Components in Gun Manufacture

Maj. Charles E. Balleisen

A German report on the application of sheet-metal stampings in the manufacture of aircraft weapons.

LIKE us, the German nation was confronted with material, personnel, machinery, and skill shortages. One of their major efforts to overcome these handicaps was the intensive application of the stamping process to the manufacture of weapons.

Among the material recently recovered from Germany is a report on the progress achieved through the use of stampings. This paper was prepared at the Posen, Poland, plant of the Deutsche Waffen and Munitionsfabriken A.G. It is dated September 30, 1943. It is presented here in literal translation with only as much editing as was necessary to fit it for the average reader.

The German report was returned from Europe by myself and D. H. Fairbanks, of the Small Arms Development Division of the Office of the Chief of Ordnance. Its value was recognized, and its publication was arranged by the chief of that division, Col. René R. Studler. The report on the application of sheet steel stampings in the manufacture of aircraft weapons follows:

THE sheet-metal stamping process used in the construction of hand arms as well as in the manufacture of machine guns for the Army and Air Corps in Germany found but limited application heretofore. While the industry at first had to content itself with constructing arms which were to be built for machining processes, it changed over as far as possible to the stamping processes.

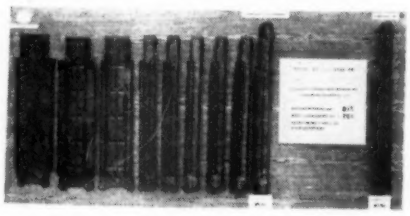


Fig. 1. Housing for 2-cm. Flak 38 gun. Stamped housing at left, machined at right.

Unusually difficult in the carrying out of this task, and inseparably connected with the conversion, was the indispensable need of interchangeability of the machined parts with the stamped parts. Such requirements could, in most cases, lead only to a compromise solution which, in final form, more or less limited the possibilities of the sheet-steel stamping technique.

The results today in stamped arms manufacture—even in view of the compromise solution—without encroachment on dependability and stability and with regard to materials, time, machine, and man saving, are so convincing that an order of the Defense Ministry was issued, against keenest opposition, for the production of stamped arms on the broadest basis.

Figure 1 shows an example of a compromise solution. The item is the housing for the 2-cm. Flak 38 gun. The weight of material required for the earlier machined parts amounted to forty-five kilograms, or ninety-nine pounds. The weight of material required for the new stamped parts with the stamped head body and two smaller milled parts amounted to 8.5 kg., or 18.7 pounds. The material saving was eighty-one per cent, and the man-hour saving was seventy per cent.

With the stamping process the entire monthly requirement was completed on three presses which were not even used to their capacity. For the additional machining processes carrying the complete monthly output, ten milling machines were in reserve.

By the machining process, the costs of machinery and the installation of motive power for all operations runs into several million marks; whereas, bearing in mind that the presses had to be newly tooled, the stamping method of production amounts to 400,000 marks in round figures.

Furthermore, whereas by the machining process, a much larger number of motive-power installations are required, including enormous operator training expenses, the punch-press or stamping method requires only one motive-power installation and one reserve installation with but few gages.

THESE facts show clearly that punch-press manufacturing methods could lend tremendous hitting power that would greatly enlarge war production with a minimum of outlay.

It has been ascertained, by comparison of the accuracy of punch presses with milling machines, that the presses, even with crude motive power, after a 10-year test have the same performance capacity, whereas the milling machines under wartime 24-hour conditions have a considerably shorter life and a much higher depreciation.

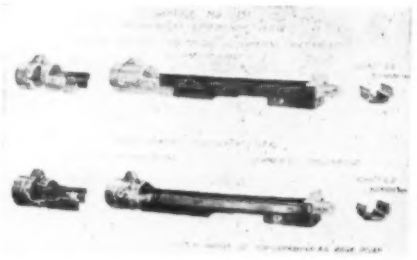


Fig. 2. Receiver for MG 151: top, forged and stamped; bottom, almost completely stamped.

The receiver of the 2-cm. Flak 38 was made by the stamping process. The finished part is a product collaborated on by Mauser and the German Arms & Munitions works. The stamped form, which at first seemed hopeless, has developed here into quite a proposition.

Major Balleisen is chief of the Machine Gun Branch, Small Arms Development Division, Ordnance Research and Development Service.

The housing consists of two 5-mm. deep-drawn sheet-steel shells, which are joined by welded seams. The stamping process permits the reënforcement of the weaker parts of the center section, which the milled housing did not allow.

The following statistics emphasize the advantages of stamping this part: Total weight of the stamped product, 29 kilograms (63.8 pounds); Finished weight, 10 kilograms (22 pounds)—the decreased weight of 19 kilograms (41.8 pounds) being obtained mainly through stamping. Total weight of the milled casings before machining, 90 kilograms (198 pounds). Material saving, 61 kilograms (134.2 pounds) or 70 per cent.

Figure 2 shows two solutions to the conversion problem of the most extensive stamped design for the MG 151 receiver. The middle part of the finished product, shown at top of Fig. 1, is stamped out of the 3-mm. (.118-inch) hard steel plate, whereas the end parts are finished more like the machined-forged part.

The weight of raw material is 22.8 kilograms (50.2 pounds). The total weight of the machined part when manufactured from a forging was 42 kilograms (92.4 pounds)—a saving of 19.2 kilograms (42.2 pounds) or 43 per cent.

The finished product, at bottom of Fig. 2, shows a casing stamped out of 5-mm. (.197-inch) hard steel plate so that only the one little end part will be finished by milling. Total weight, 13.7 kilograms (30.1 pounds); material saving in contrast with machining procedure, 28 kilograms (61.6 pounds) or 66 per cent.

The saving is also considerable in comparison with the first stamped method. The saving in labor, machinery, and men is even more favorable.

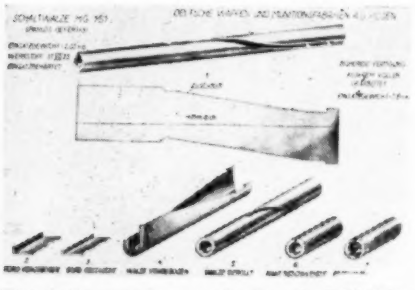


Fig. 3. Stamped cam tube for the MG 151.

In Fig. 3 is shown the solution of the conversion to the stamped process from raw material for the cam tube of the MG 151. Total weight, 2.05 kilograms (4.5 pounds); previous construction

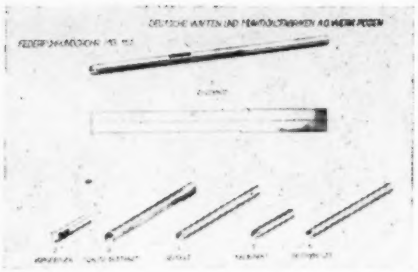


Fig. 4. Stamped spring tube for MG 151 showing process from blanking to welding.

completely machined, total weight, 5.84 kilograms (12.8 pounds); material saving, 3.79 kilograms (8.3 pounds) or 65 per cent.

Present production is out of 4-mm. (0.158-inch) sheet metal stamped and rolled with curves punched out at the same time, so that only a slight milling operation is necessary for the manufacturing process. For the bore, a machining operation is no longer necessary. A shooting test of 20,000 rounds discloses no disadvantages.

SINCE the procurement of tubing is very unfavorable, we have substituted stamped and rolled sheet metal for the production of the spring guide tube for the MG 151.

Figure 4 shows the manufacturing process. This production process also has an advantage in that the long slots are stamped, while previously they had to be milled in the tube. The man-hour expenditure is, in spite of six operations, somewhat less. The five punch-press operations require, altogether, a work time of about one minute. The total weight here, as contrasted with the machining from a tube, is somewhat higher.

For the old school of arms construction it was very instructive that the weapons produced heretofore by the stamping process not only endured each comparison, but also fulfilled the highest claim for reliability and stability. Therefore the stamping manufacture has become the pacemaker in modern arms construction.

Those arms in existence today, developed on the stamping basis, allowed a seventy- to eighty-per cent stamped model. Only thereby was it possible to produce what was hitherto considered an almost impossible number of pieces. In this connection it is worthy of mention that the Russians have produced a gun of more recent origin, ninety per cent of which is composed of stamped components. It can be most certainly assumed that the German stamped arms served as a model for the Russians, for previously Russian arms makers showed no tendency toward stamped manufacture.

Although the Russian apparatus could be indicated as of simple genius, it is too primitive in construction which probably lessens its inherent value. The fact, nevertheless, that stamped arms are being made by the enemy is so conclusive that we must be clear ourselves that the significance of this manufacturing technique has been fully recognized and that there is now need to keep our advantage in this sphere.

It is of interest that the development basis for the stamped formation of arms, as contrasted to the formation for machined manufacture, is fundamentally different. The stamping designer must adopt methods during the designing stage which take into consideration the size and strength limitations of sheet steel and at the same time strive for the simplest possible tooling requirements. In this manner designs obtain a high degree of completeness.

The manufacturer of machined parts prior to the development of the stamping process had it comparatively easy. This outstanding objective—development of the firing weapon—was free from constricting limitations. The preparations for manufacture played only a secondary part, since the most difficult cuts are possible with machine operations. This general neglect in considering production methods makes it understandable that, today, weapons are being manufactured which require hundreds of machining operations.

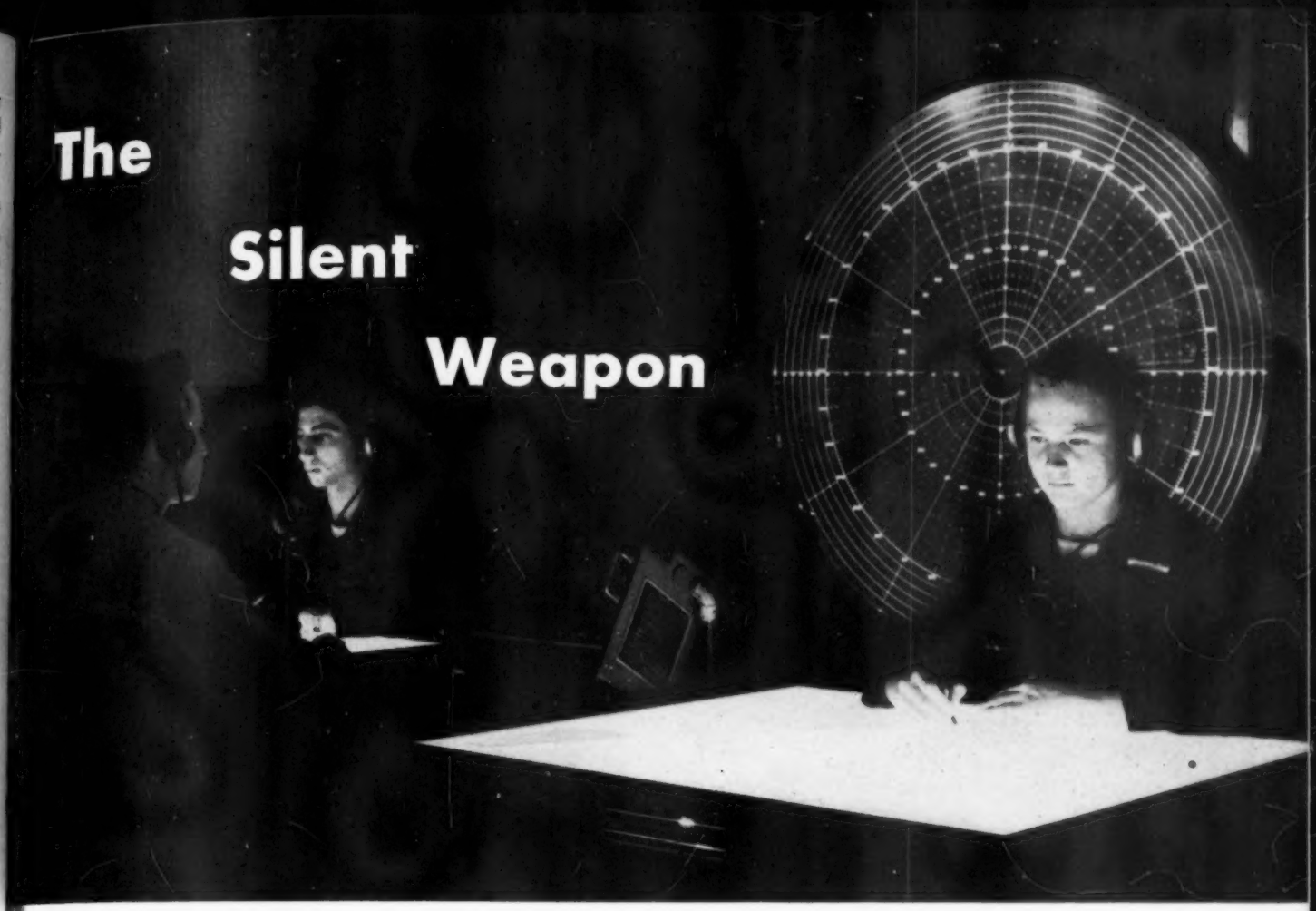
The idea of gun manufacturing by the stamped process gained much-needed impetus in that it showed the way it had to take to meet today's production requirements.

Figure 5 shows examples of the most advanced stamped form of the 30-mm.

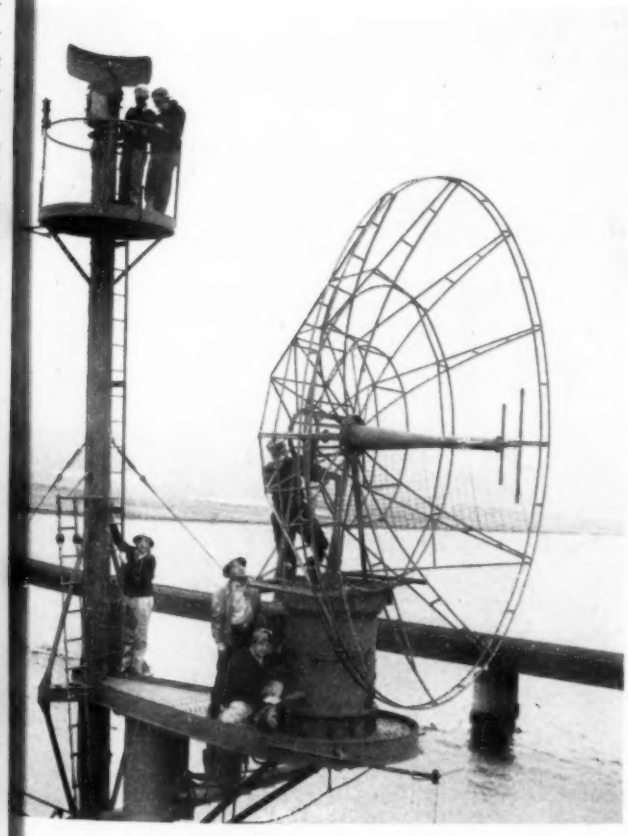
Fig. 5. The 30-mm. aircraft cannon.

aircraft cannon MK 108, which consists of over eighty per cent stamped parts. It is today even too early to go into more detail, but it can be said that the price, in mass production, will be placed between 300 and 400 marks.

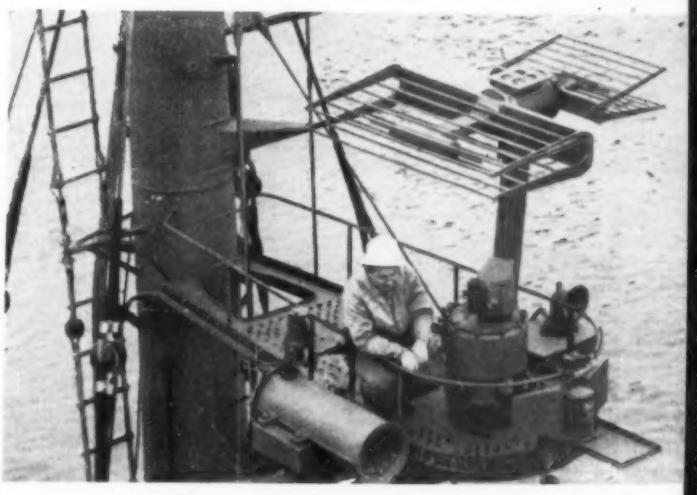
The Silent Weapon



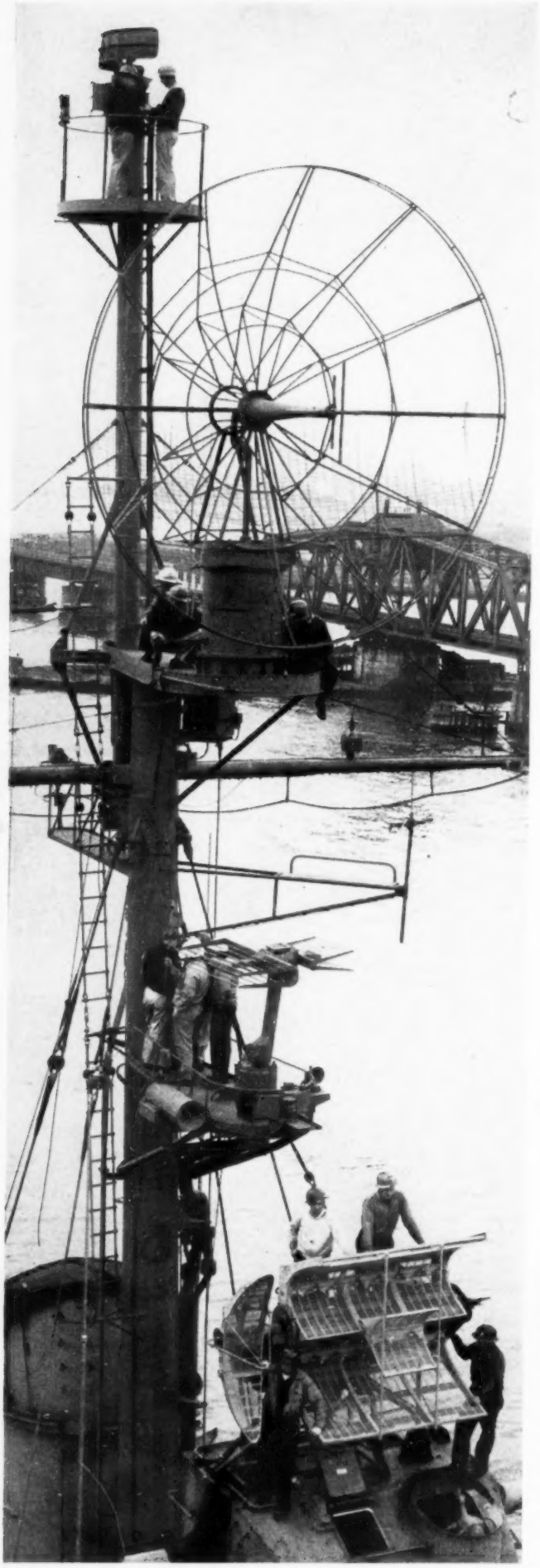
The various types of radar can be distinguished from the different antennas employed. They send out microwaves enabling ships to "see" through fog and night, to spot approaching planes and ships, distinguish friend from foe, provide fire-control data, "ride" the enemy's radar beams, and jam enemy sets.



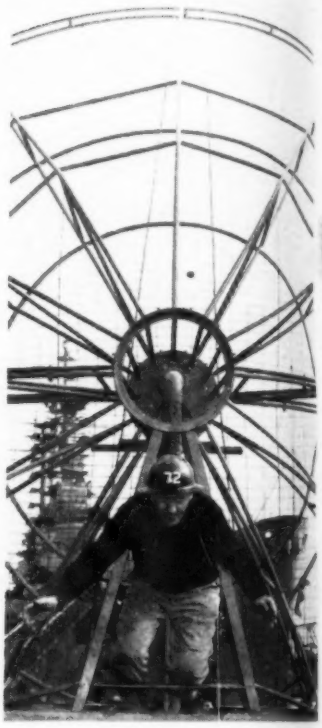
At left are shown the parabolic reflector of a sea-search radar and a "bird-cage" air-search radar antenna. At the right is a cathode tube, the eye of radar.



The "raspberry bush," above, sends out microwaves that jam enemy radar sets, thus protecting our own vessels.



In the radar plot room of an ESSEX-class carrier, above, men correlate the data provided by the ship's searching antennas.

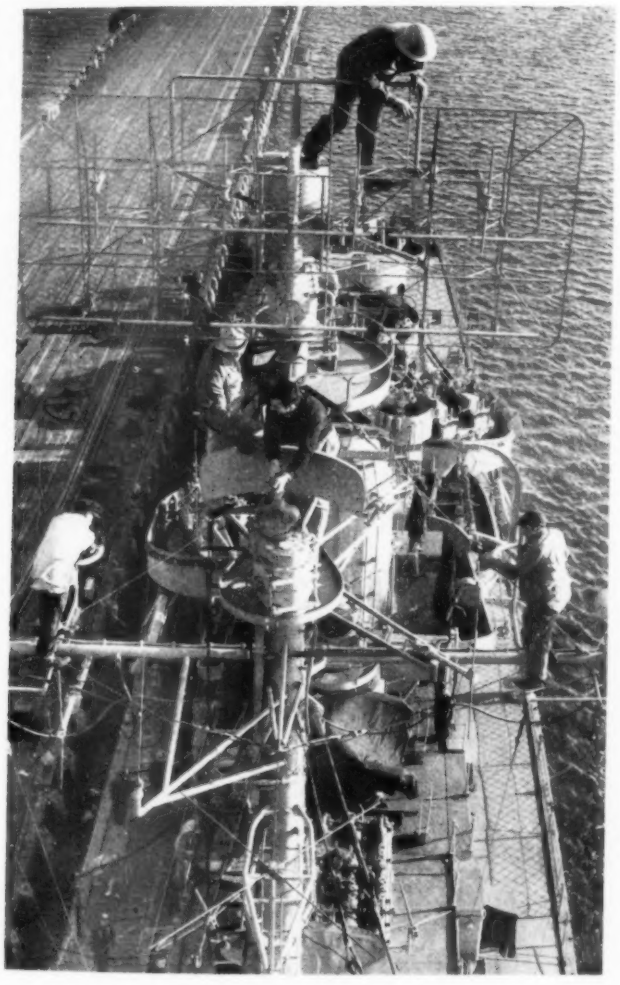


The 17-foot web antenna, right, acts as an electronic backstop to catch any radar waves reflected to a ship from enemy craft.

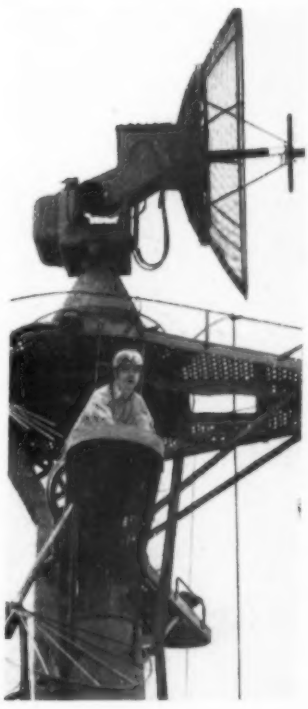
At left (top to bottom) are shown surface-search, air-search, jamming, and fire-control types of radar antennas aboard a cruiser.

A surface-search radar reflector is seen above through the grille of a huge "bird-cage" air-search radar antenna.

The Navy's antennas include the following types: 1, 2, 3, radio; 4, fire-control radar; 5, 6, 7, 8, 9, radio; 10, air-search and height-finder radar; 11, radio; 12, radar test; 13, surface-search radar; 14, radio; 15, homing beacon; 16, 17, 18, 19, 20, radio; 21, air-search radar; 22, homing beacon; 23, air-search radar; 24, 25, radio; 26, identification radar; 27, 28, radio.

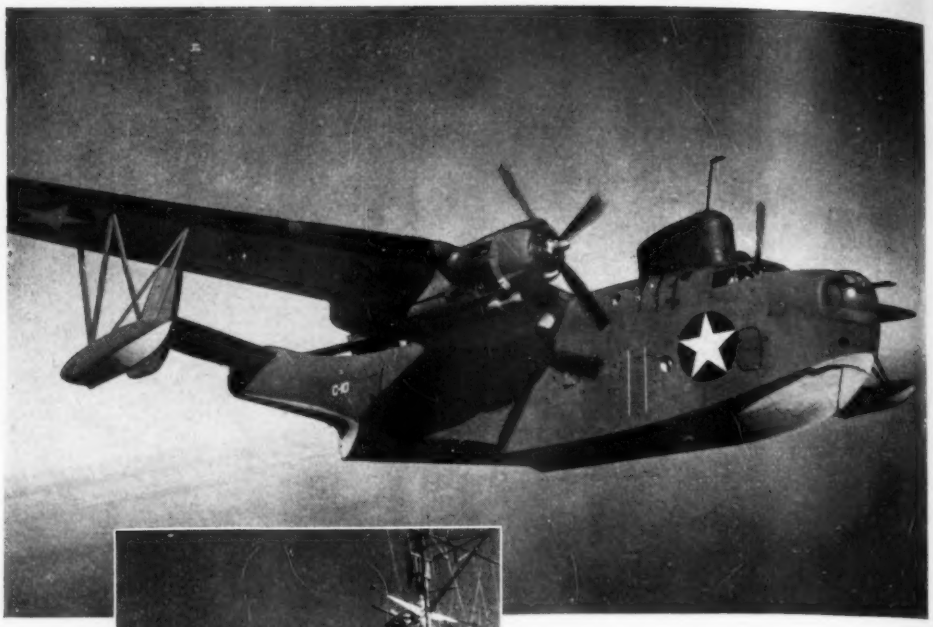


The bulblike "thinking cap" of the PT boat above houses the antenna of the radar set aboard the swift little vessel.



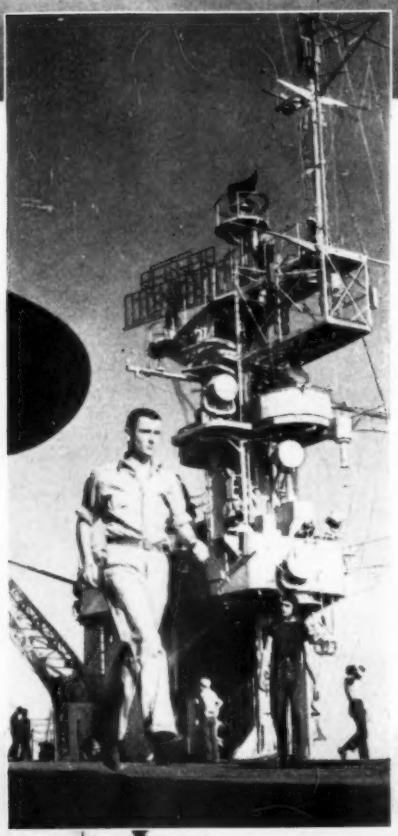
At right is a new combination search and gunfire-control "birdcage" radar antenna.

Destroyer mast at left carries "bedspring" air-search, parabolic surface-search, and identification types of radar antennas.



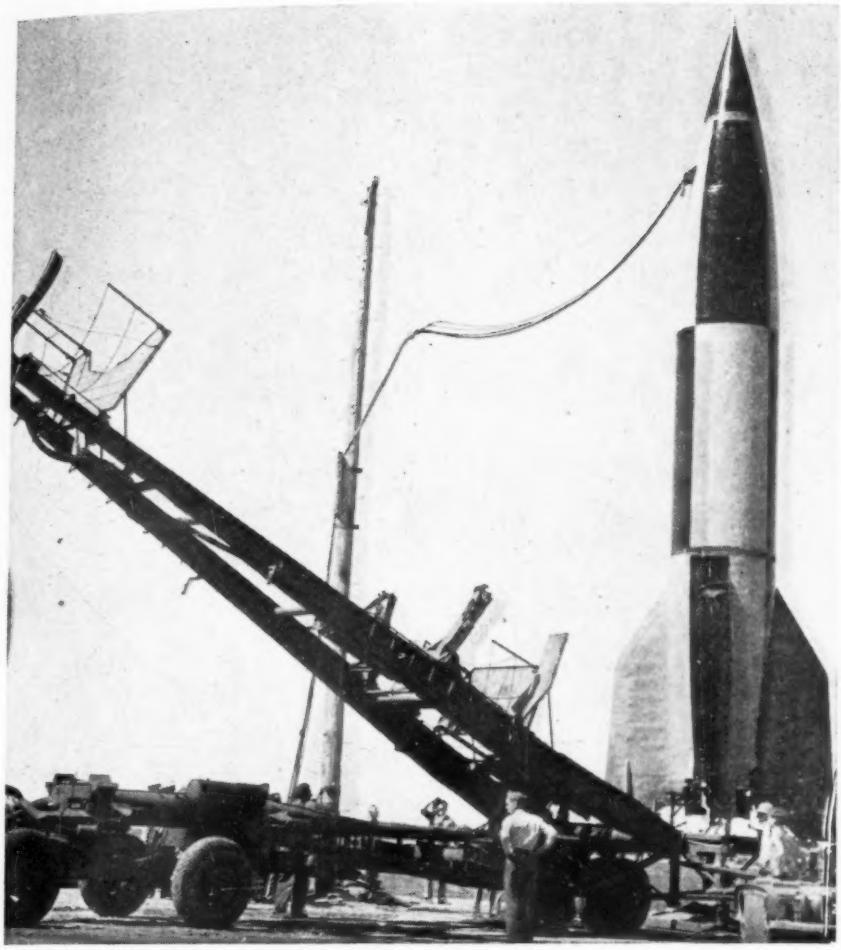
Radar equipment housed atop this Martin Mariner guides the plane toward its target or destination in darkness or fog.

Photos courtesy U. S. Navy and U. S. Steel's Federal shipyard.



The "island" aboard an escort aircraft carrier, right, is laden with radar antennas vital to air combat operations at sea.

The mighty power of the U. S. Fleet is guided and protected by the ever-watchful eye of radar—our new silent weapon.



Nazi Vengeance

The German V-2 Rocket Flies Again at the White Sands Proving Ground

by

E. J. Tangerman

Managing editor, American Machinist

"VENGEANCE" was the word that gave the German A-4 rocket its propaganda title "V-2". It differs from military predecessors in being liquid-fueled and in being far larger. Our largest rocket, the WAC Corporal, is a foot in diameter, 16 feet long, and weighs 700 pounds at launching. The V-2 is 5 feet in diameter, 46 feet long, and weighs 14 tons.

As a weapon, the V-2 was of no great significance. It was very costly considering its small payload, with limited range and accuracy. But the development of the atomic bomb changes the picture—now, the development of long-range accurate missiles is of extreme importance. Literally the sky is the limit, for the Ordnance Department is building test equipment for rockets ten times as big as the V-2.

The V-2 was no sudden development: It required twelve years of research by the best available German scientists and millions of dollars. To speed the research job, we brought parts for some twenty-five V-2's to the U. S. and placed in "protective custody" a number of German scientists who were connected with guided-missile research for over ten years at Peenemunde. The scientists are now working quietly at the Ordnance White Sands Proving Ground, N. Mex., indexing and translating captured documents, identifying rocket material, assisting in assembling and firing V-2's, and providing technical information on rocket design.

TO accomplish research objectives, the "war head" of the V-2, with its explosive filling, becomes a "peace head" filled with scientific paraphernalia for exploring the upper atmosphere and for evaluating the performance of the propulsive system and automatic controls of the rocket. The fuel supply used by the Nazis to fire rockets into London from launching areas more than 200 miles away on the Continent, with a trajectory reaching a height of 60 miles, can, when the automatic controls are set properly, thrust the missiles up to twice that height in an almost vertical trajectory ending in a safe impact area within the proving ground.

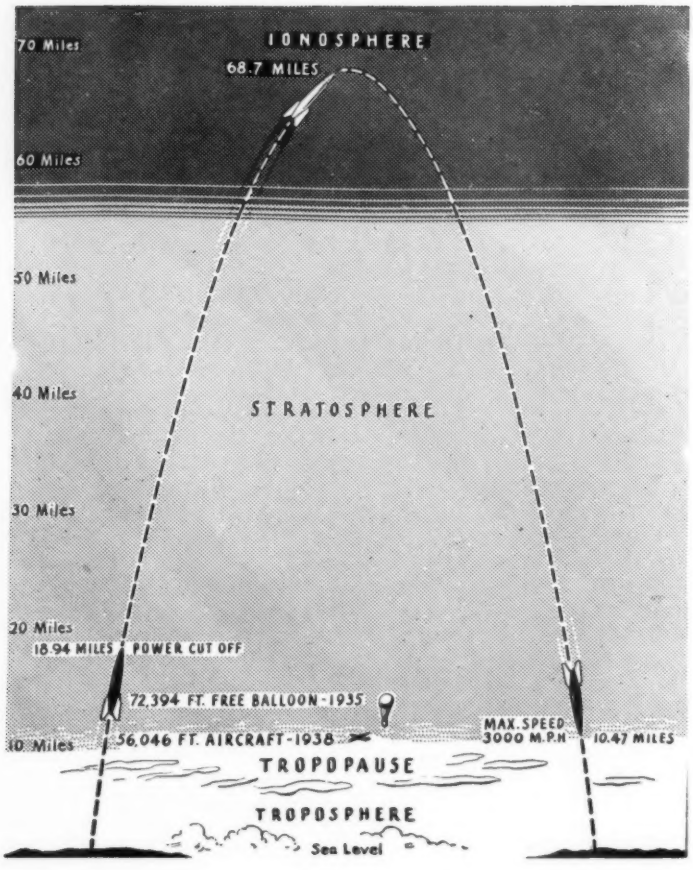
In the current firings, the height attained will be about one hundred miles. The V-2 launched May 9th went 72 miles (127,000 yards) high and landed 39 miles from the firing point. The fuel that remained, after burning was terminated by remote control, exploded

GUIDED MISSILE ERA

Tests of the Nazi V-2 rocket at White Sands Proving Ground this summer are the prelude to an era of long-range guided missiles capable of spanning oceans, and possibly the world, according to Maj. Gen. Everett S. Hughes, Chief of Ordnance.

Scientists at the Ordnance Ballistic Research Laboratory at Aberdeen Proving Ground, Md., are preparing for the advent of these supersonic rockets, General Hughes reveals. Plans are under way for a hypervelocity wind tunnel and companion hypervelocity free-flight range which will have eight or ten times the velocity of sound.

Aberdeen now boasts the most advanced supersonic wind tunnel in the world. Eventually this facility will be extended to generate winds about five times the velocity of sound—the approximate speed of Nazi V-2 rockets.



Typical V-2 trajectory.

on impact, gouging out a hole 20 feet deep and 30 feet wide.

The V-2 is propelled by the recoil from the expulsion at high velocity of a jet of gases produced by alcohol and liquid oxygen burning at high pressure in a carefully designed combustion chamber with a suitable venturi nozzle. As fired against London, about 14,000 pounds of gas expelled at an average velocity of 6,800 feet a second gave about 10,000 pounds of rocket and unburned propellants a forward velocity of 4,900 feet a second when the fuel supply was cut off and burning ceased.

This happened about 60 seconds after take-off when the rocket had traveled 25 miles along its trajectory and was moving in a direction 47 degrees away from the vertical, at a point 17.5 miles above the ground and 15.5 miles longitudinally from the launcher. The normal trajectory began at the fourth second, and the fuel was cut off at 67 seconds and 3,440 m.p.h., 22 miles from the launcher and 24 miles in the air. Maximum elevation of 50.8 miles at 176 seconds and 147 miles and impact at 306 seconds and 182 miles was achieved. This takes the V-2 through the troposphere (to 40,000 feet), the stratosphere (40,000 to 270,000 feet) and into the Heaviside layer (270,000 to 320,000 feet.) The May 10th shot went beyond into the ionosphere, establishing an American record of 360,000 feet.

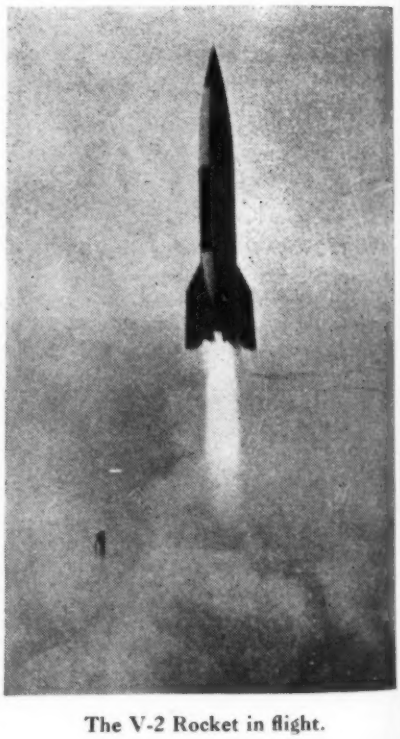
During the burning period the direction of the rocket is controlled by the action of four movable vanes on the fins in the tail assembly and four graphite ones in the jet—the latter being essential during the low-velocity starting period when the fin vanes have no aërodynamic effect. Vanes 1 and 3 in both groups are in tandem to control roll and yaw. Vanes 2 and 4 in the jet path control pitch, while fin vanes 2 and 4 act as stabilizers. Vanes 1 and 3 and stabilizers 2 and 4 (independently motored) are controlled by a gyroscope to maintain the axis of the rocket in the vertical plane through the launching and target points, thus making the rocket go in the right direction.

Jet vanes 2 and 4 are controlled by another gyroscope to produce and maintain correct inclination of the trajectory during the burning period. This second gyroscope is subject to the control of a third gyroscopic system, the real brains of the missile, which serves to maintain vertical travel to a height of about one mile, then to tilt the rocket slowly away from the vertical until it travels on the desired course. It maintains the V-2 on this course until the velocity is sufficient for the range desired, and, finally, it cuts off the fuel supply at that velocity, thus ending propulsion.

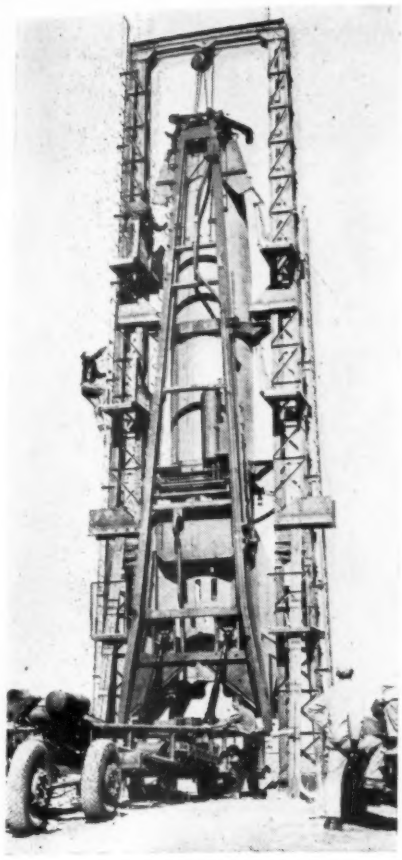
Fuel cutoff can also be accomplished by remote control from the ground. After jet propulsion has ceased, the rocket behaves like a projectile fired with the same speed and direction from a gun.

Maximum range	230 mi.
Weight, unfueled	10,000 lbs.
Weight, fueled	28,380 lbs.
Weight of war head (60% amatol, 40% metal)	2,230 lbs.
Alcohol (denatured ethyl)	8,304 lbs.
Oxygen (liquefied)	10,800 lbs.
Hydrogen peroxide	285 lbs.
Permanganate (2-gal. tank)	35 lbs.
Nitrogen (8 bottles)	30 lbs.
Length overall	46.05 ft.
Body diameter	5.41 ft.
Width across fins	11.69 ft.
Fuel capacity	2,500 gals.
Maximum velocity	3,800 m.p.h.
Velocity at impact	2,400 m.p.h.

Specifications of the V-2.



The V-2 Rocket in flight.



Test stand for rocket motors.

The mobile trailer-type launcher for V-2 rockets is a rotatable ring mounted on a steel table with adjustable legs for leveling. The rocket is 46.05 feet long, has a maximum diameter of 5.41 feet, and measures 11.69 feet across the fins. Without propellent liquids, as delivered at the launching area, it weighs about 10,000 pounds. It is securely clamped to a frame which is so hinged to the carrier that the rocket can be elevated to a vertical position and then set up on the rotatable ring of the launcher. The fins associated with the directional gyroscope are then carefully lined up with the target.

Next the fuels—alcohol, liquid oxygen, hydrogen peroxide, and permanganate catalyst—are pumped into their respective tanks and a battery of compressed-air and nitrogen bottles are charged to 200 atmospheres. When fully fueled, the rocket weighs nearly 28,000 pounds. Electric cables are connected to the missile to provide 28-volt, 60-amperes D.C. power for bringing the gyroscopes up to speed and operating them until take-off. Batteries furnish power during flight.

After all adjustments have been completed and checked, compressed air is admitted to the peroxide (83 per cent H_2O_2 at 33 atmospheres' pressure) and permanganate tanks to spray these liquids into a small steam generator at predetermined rates. The superheated steam produced in the generator drives a 580-horsepower 3,800-r.p.m. turbine operating two fuel pumps which supply ethyl alcohol and liquid oxygen to the atomizer jets on the inner surface of the combustion chamber at 1½ atmospheres.

The vaporized fuel mixture is ignited and is allowed to burn for a few seconds at a rate too low to raise the rocket from the launcher. When it is certain that the propulsive system is functioning properly, the rate is increased to normal while test and power cables are released before the jet thrust becomes sufficient to start the rocket upward.

The rocket rises vertically at first, and slowly, but it travels ever faster (maximum acceleration 6G) until about a minute later it reaches the cut-off point, traveling over 3,000 m.p.h.—nearly 5 times the velocity of sound. The jet flame which helped to keep it in sight ceases, and it is lost to view.

Maximum internal diameter of the V-2's combustion chamber is 37.3 inches; of the nozzle, 15.7 inches at throat and 29.2 inches at mouth. Average chamber pressure in operation is 220 pounds per square inch of area, and jet expansion is under one atmosphere. Combustion temperatures are over 2,650 degrees Centigrade, but the walls are held to about 1,000 degrees by the alcohol cooling. Oxygen-alcohol consumption is about 276 pounds per second, developing 58,000 pounds thrust at sea level and a top of 64,000 pounds when reduced atmospheric pressure and higher acceleration of fluids increases power.

Nitrogen does a variety of jobs in the V-2. It operates the complex valve system and maintains pressure on the alcohol tank (any oxidizer would cause an explosion). Pressure on the oxygen tank is maintained by an air ram for the forty seconds the rocket is in the atmosphere, and thereafter by oxygen evaporation in the tank and by liquid oxygen vaporized in a heat exchanger in the turbine exhaust.

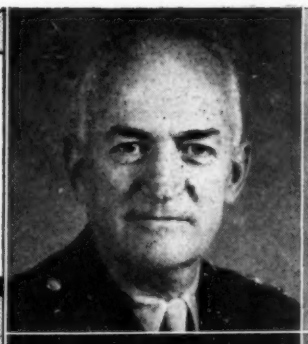
NEWLY developed radio beacons containing their own power supply are actually miniature radio receiver-transmitters and have been fitted into the V-2 "peace head" as a tracking device. Antennas are in plastic housings on the fins. During flight, the receiver is triggered from a ground radar set by impulses which cause the transmitter to repeat the impulses to the radar. This permits the trajectory to be recorded photographically.

Conventional radar equipment also tracks the V-2 for its entire flight without the aid of beacons. Since the V-2, as fired on London, contained no electronic guiding equipment, emissions of which might be tracked, this method simulates detection of enemy rockets.

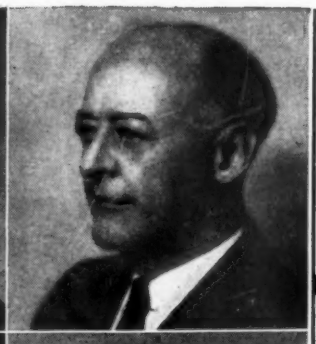
The V-2 is set by an ingenious elevating boom designed in Germany for that purpose. It is known as the Meiller wagon and is long enough to carry the V-2 with ease and set it into place by means of its self-contained hydraulic lifting system. (Illustrations courtesy *American Machinist*.)

Raising the V-2 into position from a Meiller wagon.

For Eminent Service We Salute—



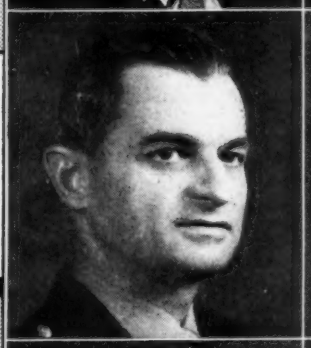
Maj. Gen. James H. Burns, a leader of industrial mobilization; wartime member, Munitions Assignments Board. Member, A.O.A. Council.



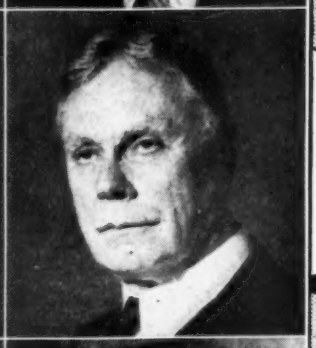
Hon. James W. Wadsworth, coauthor of the National Defense Act of 1920. Director, A.O.A.

R. J. Wysor, former chief, Metals Section, Office of Military Government of the U.S. for Germany. Former director, Cleveland Post.

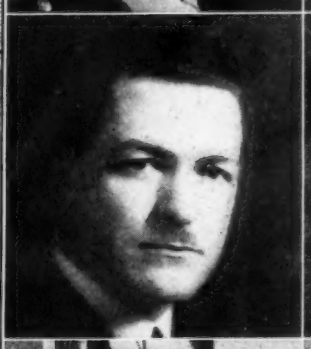
George R. Brown, president, Brown & Root, Inc., Houston, Tex. Vice-president, Texas Post, A.O.A.



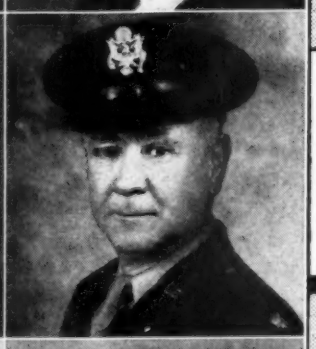
Brig. Gen. Edward B. McKinley, commandant, Industrial College of the Armed Forces, Washington, D. C.



Brig. Gen. John Ross Delafield, former chief, New York Ordnance District. Counsel, A.O.A., and member of executive committee.

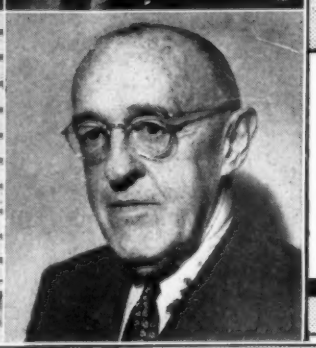


T. E. Millsop, president, Weirton Steel Company, Weirton, West Va. Vice-president, Pittsburgh Post, A.O.A.



Maj. George G. McDonald, chief, Houston Regional Ordnance office, World War II. Director, Lone Star Post, A.O.A.

Col. Charles K. Allen, the Ordnance School, Aberdeen Proving Ground, Md. Former president, Aberdeen Proving Ground Post.



Franklyn B. Cole, manager, Business Service Department, Chamber of Commerce, Los Angeles, Calif. Director, Los Angeles Post.

These Industry-Ordnance Leaders

Lieut. Col. Roy D. Hickman, formerly on staff Birmingham Ordnance District. Member, Birmingham Post, A.O.A.

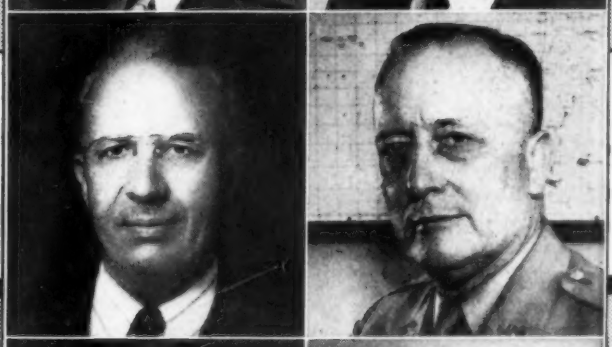
Walter F. Rockwell, president, Timken-Detroit Axle Company, Detroit, Mich. Founder Alden Prize Essay Award, A.O.A.

F. R. Bacon, chairman of the board, Cutler-Hammer, Inc., Milwaukee, Wis. Director, Milwaukee Post, A.O.A.

W. C. MacFarlane, president, Minneapolis-Moline Power Implement Co., Minneapolis, Minn. Vice-president, Northwest Post.

Col. Ralph F. Gow, served on staff of Under Secretary of War and at ASF Headquarters, World War II. Director, Boston Post, A.O.A.

William R. Ellis, vice-president, Hercules Powder Company, Wilmington, Del. Member, Philadelphia Post, A.O.A.



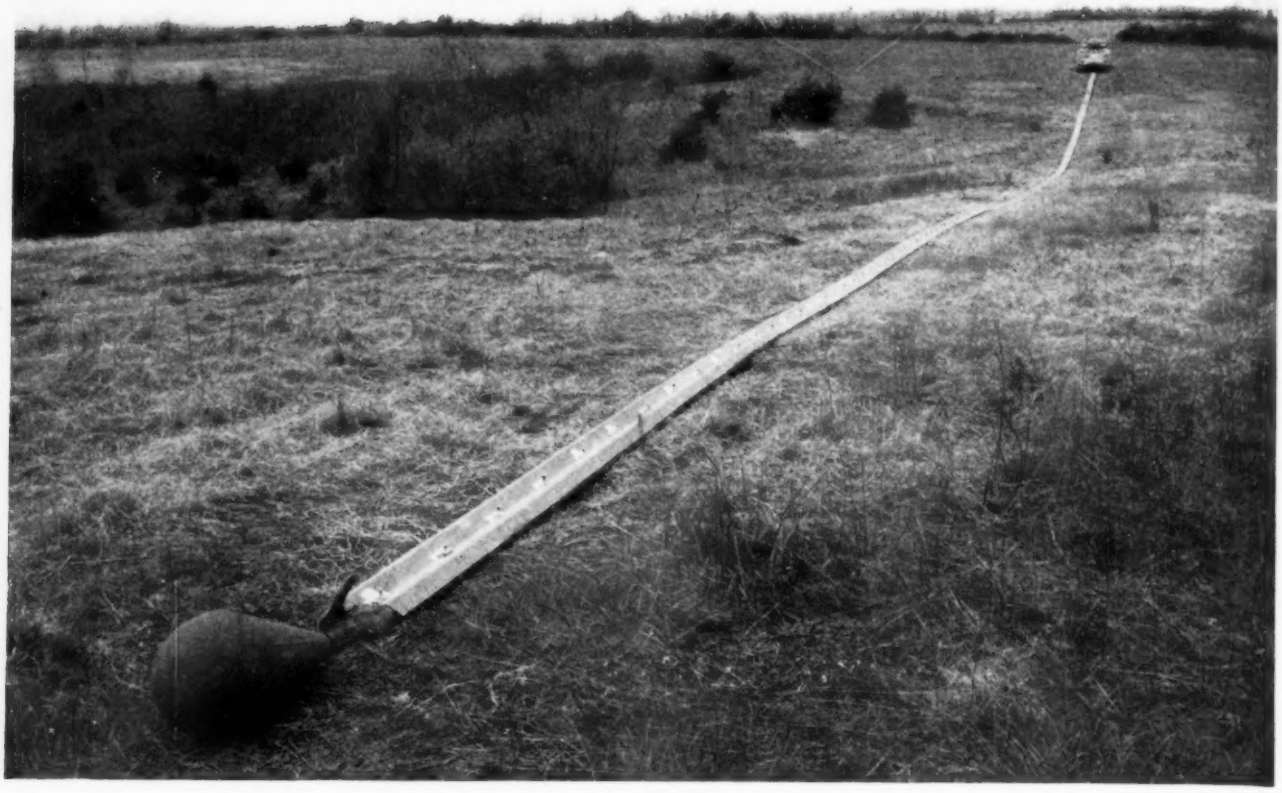
Hayward C. Thomas, president, Clarke Aero Hydraulics, Inc., Los Angeles, Calif. President, Los Angeles Post, A.O.A.

Col. Scott B. Ritchie, acting chief, Ordnance Research and Development Service. Member, Committee on Research, A.O.A.

H. P. Gant, staff, Philadelphia Ordnance District, World War II. Director, Philadelphia Post, A.O.A.

Col. Chester Mueller, former chief, New York Ordnance District. Member, New York Post, A.O.A.

Recent Army Developments



The "snake," above, pushed by a tank, is used to clear a path through mine fields by exploding a multiple series of charges enclosed between the long metal plates, detonating the mines. The M-44, below, is a new Ordnance development known as an armored utility vehicle. Using an adaptation of a tank chassis, it was designed to carry personnel and supplies in combat areas.

The Control of Atomic Energy

A Challenge to the Good Will of the United Nations

by

Bernard M. Baruch

"Peace is never long preserved by weight of metal or by an armament race. Peace can be made tranquil only by an understanding and agreement fortified by sanctions."

THE United States proposes the creation of an International Atomic Development Authority to which should be entrusted all phases of the development and use of atomic energy, starting with the raw material and including:

(1) Managerial control or ownership of all atomic-energy activities potentially dangerous to world security; (2) Power to control, inspect, and license all other atomic activities; (3) The duty of fostering the beneficial uses of atomic energy; and (4) Research and development responsibilities of an affirmative character intended to put the Authority in the forefront of atomic knowledge and thus to enable it to comprehend, and therefore to detect, misuse of atomic energy.

To be effective, the Authority must itself be the world's leader in the field of atomic knowledge and development and thus supplement its legal authority.

WHEN an adequate system for control of atomic energy, including the renunciation of the bomb as a weapon, has been agreed upon and put into effective operation and condign punishments set up for violations of the rules of control which are to be stigmatized as international crimes, we propose that:

Manufacture of atomic bombs shall stop; existing bombs shall be disposed of pursuant to the terms of the treaty; and the Authority shall be in possession of full information as to the know-how for the producton of atomic energy.

Now as to violations: In the agreement, penalties of as serious a nature as the nations may wish, and as immediate and certain in their execution as possible, should be fixed for

(1) Illegal possession or use of an atomic bomb; (2) illegal possession, or separation, of atomic material suitable for use in an atomic bomb; (3) seizure of any plant or other property belonging to or licensed by the Authority; (4) willful interference with the activities of the Authority; (5) creation or operation of dangerous projects in a manner contrary to, or in the absence of, a license granted by the international control body.

Let this be anchored in our minds: Peace is never long preserved by weight of metal or by an armament race. Peace can be made tranquil and secure only by understanding and agreement fortified by sanctions. We must embrace international coöperation or international disintegration.

Science has taught us how to put the atom to work. But to make it work for good instead of evil lies in the domain dealing with the principles of human duty. We are now facing a problem more of ethics than of physics. The solution will require apparent sacrifice in pride and in position, but better pain as the price of peace than death as the price of war.

I submit the following measures as representing the fundamental features of a plan which would give effect to certain of the conclusions which I have epitomized:

1. *General.*—The Authority should set up a thorough plan for control of the field of atomic energy through various forms of ownership, dominion, licenses, operation, inspection, research, and management by competent personnel. After this is provided for, there should be as little interference as may be with the economic plans and the present private, corporate, and state relationships in the several countries involved.

2. *Raw Materials.*—The Authority should have as one of its earliest purposes to obtain and maintain complete and accurate information on world supplies of uranium and thorium and to bring them under its dominion. The precise pattern of control for various types of deposits of such materials will have to depend upon the geological, mining, refining, and economic facts involved in different situations.

The Authority should conduct continuous surveys so that it will have the most complete knowledge of the world geology of uranium and thorium. Only after all current information on world sources of uranium and thorium is known to us all can equitable plans be made for their production, refining, and distribution.

3. *Primary Production Plants.*—The Authority should exercise complete managerial control of the production of fissionable materials. This means that it should control and operate all plants producing fissionable materials in dangerous quantities and must own and control the product of these plants.

Bernard Baruch is the United States representative to the United Nations Atomic Energy Commission. This article is based on U. S. proposals for an international atomic development authority made by Mr. Baruch at the opening session of the Commission in New York City, June 14, 1946.

4. *Atomic Explosives.*—The Authority should be given sole and exclusive right to conduct research in the field of atomic explosives. Such research is essential in order that the Authority may keep in the forefront of knowledge in the field of atomic energy and fulfill the objective of preventing illicit manufacture of bombs. Only by maintaining its position as the best-informed agency will the Authority be able to determine the line between intrinsically dangerous and nondangerous activities.

5. *Strategic Distribution of Activities and Materials.*—The activities entrusted exclusively to the Authority because they are intrinsically dangerous to security should be distributed throughout the world. Similarly, stockpiles of raw materials and fissionable materials should not be centralized.

6. *Nondangerous Activities.*—A function of the Authority should be promotion of the peacetime benefits of atomic energy.

Atomic research (except in explosives), the use of research reactors, the production of radioactive tracers by means of nondangerous reactors, the use of such tracers, and to some extent the production of power should be open to nations and their citizens under reasonable licensing arrangements from the Authority. Denatured materials, whose use we know also requires suitable safeguards, should be furnished for such purposes by the Authority under lease or other arrangement. Denaturing seems to have been overestimated by the public as a safety measure.

7. *Definition of Dangerous and Nondangerous Activities.*—Although a reasonable dividing line can be drawn between dangerous and nondangerous activities, it is not hard and fast. Provision should, therefore, be made to assure constant reëxamination of the questions and to permit revision of the dividing line as changing conditions and new discoveries may require.

8. *Operations of Dangerous Activities.*—Any plant dealing with uranium or thorium after it once reaches the potential of dangerous use must be not only subject to the most rigorous and competent inspection by the Authority, but its actual operation shall be under the management, supervision, and control of the Authority.

On July 24, 1946, Soviet Russia flatly rejected the principal points of the United States plan for global supervision of atomic energy and reiterated a demand that full control be vested in the United Nations Security Council, where five powers hold the right to veto.

Andrei A. Gromyko, Soviet delegate to the United Nations Atomic Energy Commission, categorically refused to accept the proposals of Bernard M. Baruch, United States delegate, for elimination of the veto in atomic matters and for setting up an atomic development authority outside the Council.

9. *Inspection.*—By assigning intrinsically dangerous activities exclusively to the Authority, the difficulties of inspection are reduced. If the Authority is the only agency which may lawfully conduct dangerous activities, then visible operation by others than the Authority will constitute an unambiguous danger signal. Inspection will also occur in connection with the licensing functions of the Authority.

10. *Freedom of Access.*—Adequate ingress and egress for all qualified representatives of the Authority must be assured. Many of the inspection activities of the Authority should grow out of, and be incidental to, its other functions. Important measures of inspection will be associated with the tight control of raw materials, for this is a keystone of the plan.

The continuing activities of prospecting, survey, and research in relation to raw materials will be designed not only to serve the affirmative development functions of the Authority but also to assure that no surreptitious operations are conducted in the raw-materials field.

11. *Personnel.*—The personnel of the Authority should be recruited on a basis of proved competence but also, as far as possible, on an international basis.

12. *Progress by Stages.*—A primary step in the creation of the system of control is the setting forth, in comprehensive terms, of the functions, responsibilities, powers, and limitations of the Authority. Once a charter for the Authority has been adopted, the Authority and the system of control for which it will be responsible will require time to become fully organized and effective.

The plan of control will, therefore, have to come into effect in successive stages. These should be specifically fixed in the charter or means should be otherwise set forth in the charter for transitions from one stage to another as contemplated in the resolution of the United Nations Assembly which created this Commission.

13. *Disclosures.*—In the deliberations of the United Nations Commission on Atomic Energy, the United States is prepared to make available the information essential to a reasonable understanding of the proposals which it advocates. Further disclosures must be dependent, in the interests of all, upon the effective ratification of the treaty. When the Authority is actually created, the United States will join the other nations in making available the further information essential for the performance of its functions.

AS the successive stages of international control are reached, the United States will be prepared to yield, to the extent required by each stage, national control of activities in this field to the Authority.

14. *International Control.*—There will be questions about the extent of control to be allowed to national bodies when the Authority is established. Purely national authorities for control and development of atomic energy should, to the extent necessary for the effective operation of the Authority, be subordinate to it. This is neither an endorsement nor a disapproval of the creation of national authorities. The commission should evolve a clear demarcation of the scope of duties and responsibilities of such authorities.

All of us are consecrated to making an end of gloom and hopelessness. It will not be an easy job. The way is long and thorny but supremely worth traveling. All of us want to stand erect, with our faces to the sun, instead of being forced to burrow into the earth like rats. The pattern of salvation must be worked out by all for all.

The light at the end of the tunnel is dim, but our path seems to grow brighter as we actually begin our journey. We cannot yet light the way to the end. However, we hope the suggestions of our Government will be illuminating.

Patents and National Defense

Exclusive Licensing Is an Incentive to Production

America's Patent System Was a Major Factor in Winning the War

by

Roger Sherman Hoar

"The three countries which had the best-developed patent systems in the world—America, Great Britain, and Germany—turned out to be the most formidable in waging war."

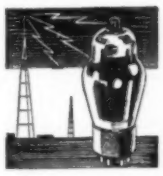
JOHN BILLINGS, the famous humorist, once remarked: "It ain't what you don't know that hurts you, so much as knowing such a lot of things that ain't so."

Recently a big business executive, with whom I was discussing some pending legislative proposal designed to hamstring the American patent system, said to me rather grudgingly: "Oh, I suppose the patent system would be a good idea if some way could be devised to stop manufacturers from buying patents which compete with their own inferior products, and then holding the improved device off the market for the life of the patent."

"For instance?" I asked hopefully. Often I had heard vague rumors of this practice, but whenever I had tried to run them to their source they had always turned out to be like the Hindu rope-trick: You never meet anyone who has ever seen that trick performed, although practically everybody knows some one who knows some one who has.

My friend sniffed contemptuously and retorted: "Haven't you heard of the carburetor which was invented just before the war, which could cut the consumption of gasoline in half for the same amount of work? The petroleum industry bought the patent and wouldn't let the U. S. Government use the device even at the height of the gasoline shortage during the war. That's how the patent system contributed to winning the war!" (A sarcastic sniff!)

I had heard of that carburetor patent. In fact, the episode was first recounted to me so many years ago that if there ever had been such a patent it would have expired long before Pearl Harbor. But now the yarn had an added twist.



So I said: "I'm especially glad that you put in that crack about not even letting Uncle Sam use the device in a national emergency. For that crack discredits the whole yarn. Ever since 1918 the United States Government has had the right to use, or have used for it, any patented invention—the patentee's sole remedy being to sue for reasonable compensation in the Court of Claims [See 35 U. S. Code 68]. So it is impossible for patents to interfere with national defense. Do you know any other instances?"

My friend sheepishly admitted that this was the only Hindu ropetrick in his repertoire.

But now, before we go on with the elusive subject of suppression of patents, let us for a moment consider the positive side of the picture. In writing this article, I thought to list some specific instances of patents which helped win the war. But I was not able to think of a single such patent. Is this strange? Of course not. For how could any single patent or group of patents help win a war? Specific inventions, yes; but specific patents, no.

It was the U. S. patent system as a whole which helped win the war by developing the habits of ingenuity and by building up the huge industrial machine which enabled our country to survive.

American, British, and Russian bravery and military science, equipped by American and British ingenuity and productivity, overcame German bravery and military science, equipped by German ingenuity and productivity. Japan never had a chance, once Germany was knocked out. It is significant that the three countries which had the best-developed patent systems in the world—America, Great Britain, and Germany—turned out to be the most formidable in waging war.

But the war is over. Granted that the American patent system, which was devised by that farseeing statesman, Thomas Jefferson, was a major factor in winning the war; granted that that system will perpetuate the industry and ingenuity which will again save us if another war should come. What of the years between? Is our patent system, unmodified, adapted to the exigencies of peace? Ought we not to prevent the suppression of inventions by some system of compulsory licensing?

The mere asking of this last question displays a complete ignorance of the nature of patents and of their contribution to the national economy.

In the first place, a patent is not the grant of a monopoly. Rather it is the retention of a partial monopoly. When a man makes an invention, it is all his—he need never even disclose it. But to induce him to share his idea with the public the Government offers that, if he will publish the full details by means of the drawings and specifications of his patent, then he may retain, by means of the claims of his patent, a 17-year monopoly in whatever is really new in his invention.

Secondly, a compulsory licensing law would probably be unconstitutional. The provision of our Federal Constitu-

Mr. Hoar was formerly assistant Attorney General of the Commonwealth of Massachusetts, and former captain (Coast Artillery Corps of the Regular Army) on the technical staff of the Ordnance Department. He is the author of "Patent Tactics and Law," and other works on law and engineering.

tion (Article 1, Section 8, Clause 8) which authorizes our patent system, reads: "The Congress shall have power to . . . promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."

Obviously a patent which is subject to compulsory license does not ensure to the inventor an *exclusive* right. The Congress need not provide any patent system at all. But if it does, the Constitution limits its authority to one sort of system, and one only; namely a system of exclusive patents.

I concede that patents are sometimes utilized to obtain for their owners privileges beyond the scope of the constitutional intent. Patents are property. Like other property, they are sometimes misused. But our general laws (in the case of patents, more specifically the antitrust laws) are adequate to prevent this abuse. There is no more reason to destroy the exclusiveness of patent rights, just because of the occasional misuse of patents, than there is to abolish the private ownership of real estate just because houses are occasionally used as brothels.

The only accusation of an abuse inherent in patents, as distinguished from other property, is the old canard of "suppression" which I mentioned at the beginning of this article.

Enemies of American free enterprise, who are seeking to cripple American industry by emasculating the patent system, keep reiterating the accusation that many patented inventions are "suppressed," meaning that big, predatory, monopolistic corporations are in the habit of keeping such inventions off the market for their own selfish ends. As a result of this reiteration, large groups of our people have been led to accept this accusation as true, in spite of the complete absence of documented instances.

There was a lot of good human psychology to the bellman in Lewis Carroll's "The Hunting of the Snark" when he boasted: "I have said it thrice. What I tell you three times is true."

Whenever an enemy of free enterprise raises this bugaboo of the withholding of patented inventions, you should demand of him names, dates, and places. The chances are ten to one that he will blurt out: "Why, all patents are suppressed. That is what patents are for." Or, if he has a bit more finesse, then like Assistant Attorney General Wendell Berge in an address last March he will deftly extend his definition of "suppression" to include all cases in which the owners of patents, even though adequately supplying the public demand for the patented goods, refuse to license all competitors at a nominal royalty.

But such "suppression" is probably the most important way in which the patent system does "promote the progress of science and useful arts," as the Constitution calls for it to do.

"The exclusive ownership of patents is the only protection which many small manufacturers have to prevent the big fellows from stealing the fruit of their mental labors."

In the first place, it is a well-recognized fact that an exclusive license to one company frequently results in more production, and hence more financial return to the inventor, than nonexclusive licenses to many concerns. Furthermore, if an appreciable investment of capital must be made before the invention can be put into production, it is almost never possible to get a manufacturer to take it on unless he has an exclusive license to protect his investment from piratical competition. This is why a wise inventor always looks for an exclusive prospect.

Secondly, the exclusive ownership of patents is the only protection which many small manufacturers have to prevent the big fellows from stealing the fruit of their mental labors. Under any system of compulsory licenses, the big fellows could obtain a license, and then force the small fellows out of business, thus building up the very monopolies which the enemies of the patent system claim to oppose.

Thousands of small businessmen, realizing that their very existence depends upon the continuation of the patent system intact, have banded together to organize the National Patent Council, of Gary, Ind., for their mutual protection against compulsory licensing legislation.

Thirdly, this "suppression" is a great stimulant for inventing. "Necessity is the mother of invention," and no necessity gives birth to more inventions than that arising from being denied the use of a novel and useful idea, the ownership of which is in someone else.

Suppose a competitor comes out with a distinct and catchy improvement on your line of goods and (quite naturally for his own protection—you would do the same) refuses to let you in on it. Suppose some individual inventor offers you a license under a patent covering some gadget you would like very much to use or to build for sale; but he has delusions of grandeur (most inventors do), and so refuses to listen to a royalty rate within reason. What do you do in such cases? You call in your own engineers, or hire a competing independent inventor, and try to "design around" the patent.

AS Judge Evans of the 7th Circuit Court of Appeals said in *Chicago* v. *Burnside*, 56 U.S.P.Q. 283, 288:

> "History records that patents are productive of greater competition in the long run than if inventions were not protected by patents. "To illustrate, an inventor brings forth an apparatus which is better and made at less cost than anything heretofore made or used in this field. All competitors are threatened with loss and perhaps ruin if an equally good product is not made and sold at prices which meet the new patented product.
>
> At once, the inventive and creative talents of competitors are aroused. They are spurred to their best efforts to produce, not merely as good, but a better, product, by a new, noninfringing method or apparatus. Thus, instead of displaying monopolistic traits, the patent fosters competition among inventors and begets new and better products at lesser costs. As a result the public is the beneficiary."

Opponents of the free enterprise system admit this but claim that it is detrimental—that all this competitive inventing is an economic waste—that the world would be better off if left to plod along with compulsory licenses under the first passable solution of each problem which arises.

Thus we see that exclusive licenses tend to result in more production than nonexclusive licenses, that the exclusive retention of patent rights is often the only protection which a small business has against its big competitors, and that nothing is more stimulating to invention than to have others possess exclusive rights to something you want.

Ordnance Roll of Honor

Colonel Morgan

Colonel Greenall

Colonel Downie

Colonel Gerber

Colonel Gray

THE Ordnance officer listed below has been awarded the Oak Leaf Cluster to the Distinguished Service Medal:

MAJ. GEN. JAMES K. CRAIN, Washington, D. C.—As a member of the London Munitions Assignment Board from July 1942 to July 1945, he performed meritorious and distinguished service in the discharge of great responsibilities.

THE following Ordnancemen have been awarded the Legion of Merit:

COL. GUNNAR C. CARLSON, Moline, Ill.—As the first commanding officer of the Ordnance Unit Training Center, later Army Service Forces Training Center, Mississippi Ordnance Plant, Flora, Miss., from July 1942 to February 1944, he made an outstanding contribution to the Ordnance training program.

COL. STEVEN L. CONNER, Watervliet, N. Y.—As Engineering Officer at Watervliet Arsenal from August 1943 to December 1944, he exercised direct control over all Ordnance engineering as related to the production of cannon.

COL. ROBERT C. DOWNIE, Pittsburgh, Pa.—As deputy district chief and later as district chief, Pittsburgh Ordnance District, from March 1943 to October 1945, he discharged duties of great complexity.

COL. THOMAS M. GALBREATH, Sharon, Pa.—He was chief, metals section, Production Service Division; and as deputy chief, Central Planning Branch, Office of the Chief of Ordnance, from November 1942 to July 1945.

COL. THEODORE C. GERBER, Chicago, Ill.—For outstanding service as chief, Safety and Security Division, Ordnance Department, from December 1943 to August 1945. His organization was charged with the critical mission of keeping to an absolute minimum the loss of life, property, and war matériel.

COL. WALTER T. GORTON, Washington, D. C.—For exceptionally meritorious conduct in the performance of outstanding services as chief, Technical Division, Office of the Chief Ordnance Officer, European Theater of Operations, from October 1944 to February 1945.

COL. JOHN D. KERR, JR., Mission, Kans.—For outstanding service as assistant to the chief of the European section, Army Service Forces; and as Army Service Forces' representative on the Joint Logistics Plans Committee, from May 1943 to August 1945.

COL. LAWRENCE C. LEONARD, West Point, N. Y.—While serving as Professor of Ordnance at the United States Military Academy from January 1942 to August 1945, he administered his department with superior ability and judgment.

COL. CLYDE H. MORGAN, St. Louis, Mo. (Oak Leaf Cluster)—For exceptionally meritorious conduct in the performance of outstanding service as chief of the St. Louis Ordnance District from

Colonel Galbreath

Colonel Carlson

Colonel Gorton

Colonel Conner

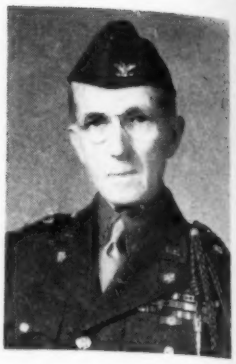
Colonel Leonard

Colonel Carten

Colonel Kerr

Colonel Gentry

Captain Goetz



Colonel McNary

September 1944 to December 1945. Colonel Morgan also received the Army Commendation Ribbon.

LIEUT. COL. FREDERICK H. CARTEN, Cambridge, Mass.—For service as chief of Ammunition Branch, Small Arms Development Division, Research and Development Service, Office of the Chief of Ordnance, from July 1942 to September 1945.

LIEUT. COL. GEORGE C. GENTRY, Auburn, Ind.—Serving in the Technical Division, later the Research and Development Service, Office of the Chief of Ordnance, from September 1942 to April 1945, he rendered distinctive and outstanding service.

LIEUT. COL. WALTER E. GRAY, Salt Lake City, Utah—From October 1943 to July 1945, he performed outstanding services at Stockton Ordnance Depot, Stockton, Calif.

LIEUT. COL. CHARLES H. GREENALL, Larchmont, N. Y.—As officer in charge, laboratory division, Frankford Arsenal, Philadelphia, Pa., from October 1942 to August 1945.

LIEUT. COL. WAYNE H. SNOWDEN, San Francisco, Calif. (Oak Leaf Cluster)—For outstanding services as a member of the War Department General Staff from October 1944 to September 1945.

MAJ. ALBERT W. HAUCK, Seattle, Wash., rendered exceptional service as director of troops, Mt. Rainier Ordnance Depot, Tacoma, Wash.

MAJ. ROBERT KRAMER, Alexandria, Va.—He served as legal adviser in the Fiscal and Legal Divisions, Office of the Chief of Ordnance, from September 1940 to September 1945.

MAJ. SILVIO C. MASSARI, River Forest, Ill.—He served in the Chicago Ordnance District from July 1942 to December 1945.

MAJ. ROBERT T. MYERS, Lafayette, Ind.—As officer in charge, Armament Maintenance School, Rock Island Arsenal, Ill., March 1941 to July 1945.

CAPT. ANDREW ANDERSON, Morristown, N. J.—As inspection assistant, New York Ordnance District, from October 1942 to February 1944.

CAPT. MYER R. CHIDAKEL, Washington, D. C.—For assignments at Letterkenny Ordnance Depot, Chambersburg, Pa., April 1943 to July 1945.

CAPT. JOSEPH A. DAOUST, Detroit, Mich.—For exceptionally meritorious conduct in performance of services from November 1943 to December 1945.

CAPT. HENRY F. GOETZ, Waterbury, Conn.—For ably directing many important projects for the development of new and improved artillery fuzes, Office of the Chief of Ordnance, from April 1943 to August 1945.

CAPT. SCHUYLER A. HERRES, Columbus, Ohio—For research and development activities at Watertown Arsenal laboratory, from 1942 to 1945.

2ND. LIEUT. WILLIAM O. HUPP, Aberdeen, Md.—For exceptionally meritorious conduct in the performance of services in the Africa-Middle East Theater.

M. SGT. JAMES K. STILL, Cullman, Ala.—For outstanding services from December 1944 to February 1945 as N.C.O. in charge, Ordnance Ammunition section, MacDill Field, Fla.

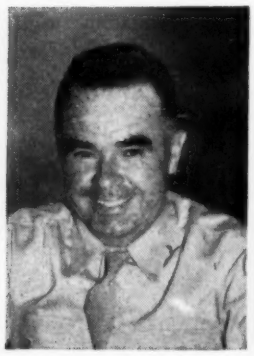
The following have been awarded special medals for exceptional and meritorious civilian service, as indicated:

LEWIS H. BROWN, New York, N. Y. (Medal for Merit)—For outstanding services on problems of management, production, and supply.

COL. JAMES E. MCNARY, New York, N. Y. (Exceptional Service Award)—For wartime assignment as special adviser to the Quartermaster General in expediting petroleum supplies.

CHARLES HILLER, JR., Arlington, Va. (Exceptional Service Award)—For his outstanding contribution to the Ordnance Department in the design and development of new equipment.

R. S. WHITTLESEY, Caldwell, N. J. (Meritorious Service Award)—As assistant to chief of facilities branch, Office of the Chief of Ordnance, he did an outstanding job.



Sergeant Still

Mr. Brown

Colonel Snowden

Mr. Whittlesey

Mr. Hiller

The Ordnance Orphan

The Department Adopted the Submarine Mine Depot at Fort Monroe, Virginia

Col. D. S. Lenzner

WHEN the Grim Reaper under the cloak of War Department Reorganization Circular No. 59 of 1942 struck down in one swath the chiefs of nearly all combat arms, the Ordnance Department adopted an orphan. Unlike the usual procedure of adoption wherein the foster parents select the child, this child was assigned by the brief dictum, "(h) includes present supply functions of CAC," which appeared as a footnote on Chart D "Organization of the Services of Supply" appended to that circular.

Differing also from the usual circumstances of adoption, this orphan was some 70 years old. But even now after having lived quite happily for some four years in the hospitable Ordnance family, comparatively few Ordnance officers and even a smaller percentage of Ordnancemen at large know of its existence.

This orphan is the Submarine Mine Depot at Fort Monroe, Va. It began its existence shortly after the Civil War as the Engineer School of Application and later became the Engineer Depot at Willets Point, N. Y. In 1902, after having been transferred by act of Congress, approved February 2, 1901, to the Artillery Corps along with responsibility for the care and use of submarine mine defense, it was redesignated the Torpedo Depot, Fort Totten, Willets Point, N. Y.

Subsequently renamed the Fort Totten Submarine Mine Depot and the Submarine Mine Depot, Fort Totten, N. Y., this agency moved during the winter of 1930-1931 to Fort Monroe, Va., and since February 16, 1931, has operated at the latter station. Initially housed in various available scattered buildings at Fort Monroe, in November of 1940 it moved into a new structure built under special appropriation from Congress and especially designed for its use.

AS the single agency in the United States Army which has dealt exclusively since 1902 in matters concerning submarine-mine matériel, it had operated, since the creation of the Office of Chief of Coast Artillery, as a section of that office. The mission of the depot had been delineated in Army Regulations as "a branch depot charged with the development of submarine-mine matériel and methods; with the procurement of special supplies of submarine-mining material as designated in procurement lists approved by the Assistant Secretary of War; with the storage and issue of submarine-mine property; and with the preparation of instructions for use, care, storage, and disposition of this property."

Although this agency has always included the word "depot" in its designation, the word "arsenal" would be more descriptive in Ordnance parlance of the operations performed. Since March 1942 these operations comprised research and development under the Research and Development Service and procurement under the Industrial Service of the Ordnance Department.

Because it is used only in the defense of harbors, a controlled submarine mine differs from other Ordnance weapons in that it is never taken onto a battlefield and is therefore not subject to capture and subsequent analysis by the enemy to determine its method of operation. Unless the enemy captures a harbor with its mine system intact he can learn the principles of operation of that mine system only through other means of intelligence. For these reasons the greatest secrecy surrounds the mine defense of every nation.

The widespread publicity given to our offensive mining operations against our enemies overseas has contributed to the fact that comparatively few civilians ever knew that defensive controlled submarine mines were employed in World War II and that they were planted and maintained by Army rather than by Navy personnel.

Mines designed for underwater planting and firing are designated as submarine mines to distinguish them from antitank or antipersonnel mines which are normally used on land. Submarine mines may be classified according to the ways they are planted, their methods of arming, or their means of firing. Those designed with a negative buoyancy so that they rest upon the bottom of the sea are known as "ground mines." Those designed with a positive buoyancy are known either as "buoyant mines" (if they are held in place by anchors and mooring ropes or chains) or as "floating mines" (if they are designed to move with the current).

As to their methods of arming, they are classified as "contact mines" when

Security measures surrounding submarine-mine warfare are rigidly enforced since knowledge of the principles of operation can be obtained only by espionage.

Colonel Lenzner is commanding officer of the Ordnance Department's Submarine Mine Depot, Fort Monroe, Va.

they require actual physical contact with a ship to arm them or as "influence mines" when they do not require physical contact but are armed by the magnetic, sonic, or other influences of moving ships which pass near by.

As to their means of firing, mines are classified as "controlled" if the firing can be subject to the will of an operator ashore, or "uncontrolled" if they fire immediately after being armed by a ship. A controlled mine, the type used by the Army in harbor defense, must be connected to its firing power ashore by means of submarine mine cable. An uncontrolled mine, the type used by the Navy and Air Corps for offensive purposes, contains its own firing battery which will cause it to detonate under conditions of its design against any ship, friend or foe.

Development of the U. S. Army-type controlled submarine mines was begun about 1869 by Col. Henry L. Abbott of the Corps of Engineers. They were designed for placement in the navigable channels of harbors where they might provide an electrically controlled defensive barrier capable of being opened or closed by the defense commander.

A typical controlled submarine-mine installation consists of one or more parallel lines of mines planted generally at right angles to the direction of harbor traffic. Mines in any line are separated by intervals approximating the diameter of the area within which detonation of the mine will cause vital damage to an enemy vessel.

Buoyant mine to guard anchorage.

Any convenient number of mines in any line normally less than twenty is known as a group. Each mine of a group is connected by single-conductor armored submarine cable, known as the mine cable, to a central point in rear of that group known as the distribution box. Each distribution box is connected by the same type cable, designated the shore cable, to a manhole or dugout at the water's edge which is called the cable hut.

To minimize danger from a single shell or bomb, a cable hut is provided for each eight or less groups, and cable huts are separated from each other a distance equal to the danger area of the largest expected shell or bomb. Cable huts in turn are connected by multiconductor armored cable in trenches, known as land cable, to a bombproof control room called the casemate.

AT least one conductor of land cable is required for each group of mines, and spares are normally provided in case of damage to conductors in use. Land cables should follow different routes from the casemate to cable huts, and, if practicable, cable huts should be interconnected by land cables to provide flexibility in case of damage.

Rapid-fire gun batteries sited to cover the mine field to prevent damage by hostile mine sweepers are also provided as a part of the typical harbor-defense mine installation.

There is no standard unit of mine matériel for issue to harbor defenses which is comparable to the unit of issue of any other ordnance matériel to companies, battalions, or regiments. Each harbor defense requires a "tailor-made" controlled submarine mine installation which is dependent upon local hydrographic conditions.

Harbors with wider navigable entrances require more groups of mines per line across those entrances. Deeper waters require detection devices with greater sensitivity than do shallower waters. Influence-operated mines which give satisfactory stability on sandy or muddy bottoms may not be stable on rocky bottoms. The stability of influence-operated mines may also be affected by tidal current.

The amount of land cable required in any installation is dependent not only upon the number of groups of mines in a harbor but also upon the physical distances between the casemates and the cable huts.

Recommendations as to whether or not controlled submarine mines should be used in defense of a given harbor are normally initiated by a joint Army-Navy planning committee. After final approval of such recommendations by the War Department a secret plan, known as the approved submarine-mine defense project for that harbor, is drawn up.

Based upon this secret plan the local Coast Artillery mine organization prepares a detailed list of the matériel required to install, operate, and maintain that mine field for a given period (normally one year) during hostilities. When these lists have been reviewed and approved by harbor-defense commanders, the Submarine Mine Depot, and the Chief of Ordnance, they become known as approved project requirements. The total of all individual harbor-defense requirements, plus a stipulated central reserve, establishes the procurement objective for the Depot.

In view of the fact that the underwater matériel for any mine project weighs approximately sixty-five tons per group, all matériel except the explosive is normally stored within the harbor defense. Here it is available for planting when directed by the War Department in time of war or of threatened hostilities. Thus any possible delays due to the breakdown of transportation facilities beyond the limits of the harbor defense are eliminated.

For some years prior to World War II the depot had paid particular attention in the selection of parts for incorporation into controlled submarine-mine systems that were either standard commercial items or those differing to a minimum extent from standard commercial products so that they could readily be procured from manufacturers with a minimum change-over in production methods or machinery. The soundness of this policy was proved when procurement of mine matériel was undertaken during World War II.

Between 1920 and 1940, procurement of submarine-mine material, except for small quantities of new cable, was practically nil. Each harbor defense which had an approved mine project already had on hand all the necessary matériel for planting that project which had been possible of procurement within the limited annual appropriations.

Prior to 1937 the total annual appropriation for development, procurement, and maintenance of the mine defense of continental United States, Panama, and the Philippine Islands had been less than $60,000. During these same lean years the total training in the loading, planting, and firing of submarine mines by the using service was confined to about one month each year during which the annual mine target practice was held.

Since these target practices were each given a score which was published to the mine service at large, each mine organization was more concerned with planting under ideal conditions in sheltered areas than it was in risking the rigors of open-sea operations in the vicinity of its actual wartime mine field. Because of this and the fact that controlled submarine mines had not been used in war by the United States since 1865, very little information on the performance of mine matériel under war conditions was available prior to 1940.

In July of that year, through the efforts of the Submarine Mine Depot, which in those days also had a troop-training mission, mine batteries were relieved from all other duties and were required to plant and continuously maintain at least two groups of inert-loaded mines as near the location of their war fields as peacetime navigation regulations would permit.

At this time buoyant mines were standard, and, although damage to ships by explosion was impossible due to the inert loading, these mines were a mechanical menace due to their ability to bend propeller blades or foul them up with steel wire mooring rope. This fact and other considerations noted in the remainder of this article led to the search for a suitable mine of the ground type which would detect passing ships from positions on the bottom of the harbor.

The total personnel on duty at the Submarine Mine Depot in December 1939 comprised three officers, twelve enlisted men, and ten civilian employees. The mine-control system employed throughout World War II, which had been under development for a number of years previous, was standardized on May 1, 1940. Between that date and November 15, 1941, the depot, with a shop force augmented by thirty-three men detailed on temporary duty from Coast Artillery mine batteries, undertook and satisfactorily completed the first mass-production effort in the history of the depot. This effort consisted in manufacturing a completely new mine-control system for all the mined harbors in the United States, Panama, and the Philippine Islands.

When the controlled submarine mine fields were ordered planted by the War Department during World War II, the installations were made with the then-standard equipment which included buoyant mines. Prior to this time, investigations of the practicability of designing a mine that would rest on the bottom—a ground mine—to replace the standard buoyant type were underway at the depot.

Submarine Mine Depot where all types of mines designed for guarding our harbors and anchorages are developed.

It had long been realized that the use of buoyant mines in war would be objectionable for the following reasons: First, buoyant mines tear loose from their anchors during heavy winter storms while ground mines require no anchors; secondly, buoyant mines preclude the use of mine sweepers to remove influence-operated or buoyant mines planted by the enemy.

An enemy power strong enough to carry war to our shores would probably drop large numbers of airplane-planted mines in our harbor channels and mine fields. These mines would have to be removed before our Navy or commercial shipping could move in or out of our harbors and before any repairs could be made to our own mine fields. The use of ground-type controlled submarine mines would make such daily sweeping possible and still retain an effective mine defense.

In addition, being planted at 100-foot intervals and requiring physical contact with a vessel in order to detonate automatically, buoyant mines were at best a poor screen against submarines whose beam approximated twenty-five feet. By simple mathematics, it can be determined that a submarine would have a three-to-one chance of successfully passing through a single line of mines without danger to itself. A device which would detect ships by one of their physical characteristics rather than by actual contact held out an answer to this deficiency.

Efforts at the Submarine Mine Depot were directed initially toward the perfection of an "influence" detector which could be placed midway between two mines with a view to closing this 100-foot gap against the entrance of submarines. Later the installation of some type of "influence" detector within the mine itself was investigated, and this in turn led to the idea of a ground mine containing a larger charge of explosive which would be planted on the bottom of the channel thereby eliminating all the previously stated objections to buoyant mines. Continued investigation by Army and Navy mine-development personnel resulted in the production of suitable detection devices for use with controlled submarine ground mines.

COMING more than a year after Pearl Harbor, changes in the size of projects and the basic design of mine, which latter carried with it a tenfold increase in the amount of explosive per group, presented a procurement problem during the period of hostilities which had not previously confronted the Submarine Mine Depot. By enlisting the aid of manufacturers whose commercial peacetime product had been steam boilers, the requirement for mine cases was met at a satisfactory rate.

In addition to supervising, through its field-service suboffice, the rehabilitation and maintenance of submarine-mine matériel in the hands of badly depleted harbor defenses, the efforts of the depot are being devoted to the perfection of new mine-control and ship-detection devices which the progress of construction of ships has indicated as necessary to an adequate controlled-mine defense.

Wars of Atomic Destruction

A Critique of "The Absolute Weapon"

by

Hoffman Nickerson

"Today's world is so disunited that the rapid creation of any moral unity would be a stupendous miracle. Accordingly we must long remain in great danger, bomb or no bomb. The prospect of atomic mass massacre merely highlights the darkness like a flash of lightning at midnight."

AMID the torrents of print about the atomic bomb, it is a pleasure to welcome "The Absolute Weapon" (New York: Harcourt, Brace & Company, 214 pp., $2.) for which Bernard Brodie makes himself responsible both as contributor and editor. His naval writings have established both his technical military competence and his responsibility as a citizen.

The grateful reader is therefore guaranteed in advance against fairy tales, hysteria, and the threatened treachery of those scientists who have openly proposed to violate the security of their respective countries.

This brief notice will confine itself largely to Mr. Brodie's own chapters on the new bomb as a weapon. Of the other sections concerned with political consequences and possible methods of control, we note only that certain of his collaborators seem unduly optimistic as to the effectiveness of international agreements.

On the other hand, Percy E. Corbett (pp. 163 and 174) writes the epitaph of such agreements as follows: "The . . . essential condition of peace in an atom-splitting age, as before, is . . . acceptance of common values"—by which he means common moral values; *i.e.*, moral unity. And again: "It would be . . . dangerous to create a machinery of central force before one . . . of central justice. For . . . judgments would have to be based upon a world-wide community of values . . . which . . . does not exist today."

Having for years hammered away at this point, the reviewer applauds its restatement. But, alas, Mr. Corbett thinks that mere organizational machinery may create morals, whereas it is the other way around. In our own lives we know all too well that only existing morals can make any organization work.

IN the realm of motives, blueprints are negligible—the sword of the spirit is the only absolute weapon. Today's world is so disunited that the rapid creation of any moral unity would be a stupendous miracle. Accordingly we must long remain in great danger, bomb or no bomb. The prospect of atomic mass massacre merely highlights the darkness like a flash of lightning at midnight.

The book emphasizes the point that the new bomb is suitable only for wars of an almost unprecedented sort; *i.e.*, wars of vast and indiscriminate physical destruction. Its technical observations group themselves around this central theme and are subordinate to it.

We read on page 62 that although "the bomb is new, . . . the people who developed it were able to avail themselves of the fabulously elaborate and advanced technology already existing. Any new device created today is already at birth a highly perfected instrument." Thus a gradual and very considerable further development like that of the steam engine over a whole century seems improbable. The existing bomb is quite enough to set the pattern for future wars. Even should it not be used, the threat of it will fundamentally affect strategy.

General Arnold's statement that today only "the very heavy bomber" is a suitable carrier is accepted. Whether future carriers will be bombers or rockets and from whatever fixed or moving bases on land or at sea such carriers may be launched, obviously the most promising targets for atomic explosives with their great range of destruction will be found in cities.

Thus the new weapon enlarges the theoretically familiar pattern of "pure" air strategy in which the main effort is made not against the enemy's organized forces but against rear areas; *i.e.*, against his civilians. At the same time, however, atomics give this vile and barbarous strategy a new twist favorable to the attack.

The strength of the defense in preatomic bombing campaigns proved to be very great, and the measure of offensive success was small when compared with the prolonged and colossal efforts made. In postatomic bombing, on the other hand, a very few carriers, which through their small numbers may well catch the defense off guard, may achieve vast and very possibly decisive results against an entire nation. Nor could the most vigilant defense have a good chance of stopping all the attacking carriers if those carriers were numerous.

On present indications, therefore, the one political deterrent against attempts at atomic surprise will be the fear of atomic retaliation. Nevertheless that fear is formidable. Whereas efforts to disperse and to build shelters, however useful and desirable, will probably fall short of real effectiveness, it will be comparatively easy to protect, conceal, and disperse enough bombs and appropriate carriers so that no initial attack could prevent a prompt and very heavy counterstroke.

The cities of the nation first attacked might be destroyed, but a like fate would almost at once be inflicted on those of the attacker. All that the latter could hope to gain, therefore, would be a short advantage in evacuating his city

Hoffman Nickerson, noted author and military historian, is a frequent contributor to this journal.

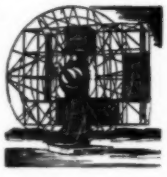
dwellers into his countryside. Even the manufacture of bombs and appropriate carriers might continue for some time after an attack, since special measures inapplicable to large cities could be taken to ensure such continuation.

Against a country inadequately prepared for retaliation, atomic bombardment of cities might be decisive. Against a wholly unprepared nation the mere threat of bombardment might result in a successful "war of nerves" which would result in surrender to the threat alone. The normal case, however, and the only theoretically interesting one would be a war beginning with long-range bombardment promptly followed by retaliatory counterbombardment.

Such an opening would be only a variant of the primitive strategy of cross-raiding in which each side tries to damage the enemy's civilians and at the same time to avoid contact with his fighting men. In former times cross-raiding was always possible, chiefly by means of cavalry raids on land and the destruction of commerce at sea; but in preairplane days it was found to be both unprofitable and ineffective.

Between civilized states the resulting physical destruction advantaged neither party, and the decision was postponed until one side achieved superiority in organized force—in armies or battle fleets—whereupon that side invariably got the better of the raiders. Even preatomic air bombing seemed to be following the same pattern except that the physical destruction involved was proportionately greater, while now the prospect of wholesale baby killing and other forms of civilian damage, no matter how horrible, may still prove indecisive.

Indeed the characteristics of the new bomb seem to make an indecisive result of atomic bombing and retaliation more likely than a similar result before the atomic explosives were invented—always provided that the side first attacked has carefully prepared to retaliate. With old-fashioned explosives the number of bombs which got home on a city was important, while the damage done by a single atomic bomb is so great that a comparatively few well-aimed ones might cripple, or at any rate damage very severely, an entire national economy.



The capacity of cities to "absorb" atomic-bomb damage is so small that the curve of diminishing returns from the use of such bombs would soon begin to fall steeply. In other words the "critical number" of bombs will be comparatively small, and those dropped afterward will accomplish much less.

On the other hand, a country not well prepared technically to retaliate would be almost helpless. Probably only one that had enormous territory and an extremely hardy, primitive population would be able to resist at all.

The most valuable sections of the book are those which clearly analyze the requisites for future preparedness. All previous military thought must be drastically reviewed, for the gradual building up of industrial mass production in event of another war will be wholly impossible. Whether for atomic retaliation, for the invasion which will promptly follow a successful atomic bombardment, or for defense against such invasion, only forces already fully in being at the outbreak of war will count.

Returning to defensive measures, although the possibilities of passive defense and dispersion are limited, they should not on that account be neglected. On the contrary, they should be fully developed. "Linear" or "ribbon" cities are unreal fantasies. Density of population is the thing to be avoided or at least diminished.

AS to general military policy for the immediate future, the reviewer differs from the author chiefly in that the latter takes for granted the range and navigational accuracy of tomorrow's planes. They may indeed develop as he anticipates, but until they do so sea power will remain far more important than the book admits. Consequently a blending of U. S. air power and sea power, with the latter recognized for the time being at least as the dominant partner, would seem the firmest foundation for our national strategy.

In closing, two points suggest themselves which round out the argument of the book although they are not found in its pages. The first carries forward an idea of Ardant du Picq who noted before his death in 1870 that in the days of hand weapons, individual armor, and shields, the risk of injury in combat was small as long as the ranks of one's own side held firm. In ancient battles the killing was almost entirely of fugitives after one side had broken.

With firearms, however, the scene changed. Individual skill and trusty comrades could not guarantee a man against the impersonal impact of bullet.

The range of the preatomic bombing plane went a long way toward transferring to the noncombatants of the side which was weaker in air power the risk of wounds and death and therefore the necessity for discipline to prevent panic.

Our second point is that only one assumption can rationally justify a war in which not only the world of which the victor is a part but also the victor himself must expect fearful losses. That assumption is that the wickedness of the enemy, and therefore the menace of his continued existence, is such as to justify almost unlimited efforts and sacrifices in order to destroy him.

Very soberly and irrespective of our individual wishes in the matter we must admit that this is indeed the temper of the present day. Twice within half a century wars have been fought on such a scale and with such intensity that no other mood can explain them. No peace, not even the prospect of a temporary truce, has resulted. While our atomic monopoly lasts it is unlikely that we shall be directly attacked. Before that monopoly ends we can at least make certain that if attacked our reaction will be powerful.

A.O.A. BOOK OF THE MONTH

The Book Service department of the Army Ordnance Association is happy to announce as its first Book of the Month "The Absolute Weapon" edited by Bernard Brodie and written by him and other members of the Yale Institute of International Studies. The book deals with the atomic bomb as a weapon of war, its political consequences, and future control.

As a special service, it is offered to Association members at $1.70—a saving of 15 per cent over the standard retail price. Address requests for copies to the Army Ordnance Association, 705 Mills Building, Washington 6, D. C.

Evolution of the Submachine Gun

The "Glorified Pistol" Has Become a Part of America's Firepower

by

George R. Gans

Inventor, author, soldier

THE submachine gun, as we know it today, had its origin in the 32-shot drum magazine and shoulder stock which, when fitted to the German Luger service pistol, transformed it into a small carbine whose lightness and bad balance made it unsuitable for military use. However, this improvised pistol-carbine arrangement led to the development of the Bergmann machine pistol 18.I, a fully automatic carbine rather than a pistol, using the same ammunition and magazine.

The MP 18.I was introduced into the German services as a defensive arm, one gun being issued to the noncom in charge of each machine-gun crew. The Bergmann served to correct the machine-gunners' paradoxical position of providing defensive firepower for the infantry while at the same time they themselves were highly vulnerable in close combat.

This first tactical use of the submachine gun proved it a convenient close-range automatic weapon extremely handy for trench use. Unfortunately, insufficient experience prevented a detailed study, and, in its final analysis (if, indeed, there was one), the machine pistol was regarded as a mere military curiosity—nothing more than an over-glorified pistol. Classified as a highly specialized, limited-purpose weapon, unworthy of any earnest military consideration, it became lost in the shuffle.

The famous Thompson submachine gun arrived in 1919, too late for the war, but it later attained such great notoriety as a "civilian" weapon during the gang wars of the 'twenties and early 'thirties that the name "tommy gun" has since been applied to all submachine guns. The civilian use of the "Chicago chopper" (and the use of the Bergmann during postwar uprisings in Germany) kept the application of the submachine gun in the public eye, and thus prevented its vanishing into oblivion during the years of "peace" in which the military failed to see any value in this detested "gangster's gun."

THUS, kept alive by transfusions received from the press, it persisted until the mid-'thirties when, war again a probability, it had the opportunity to exhibit its military potentialities.

Until 1935 there had existed but two basic types of submachine gun: the 1918 Bergmann and the Thompson, of 1919 vintage. The submachine gun could, at that time, be likened to the 20-year-old fellow who was only two feet tall because he was lost at the age of one and was not found until nineteen years later —under the icebox!

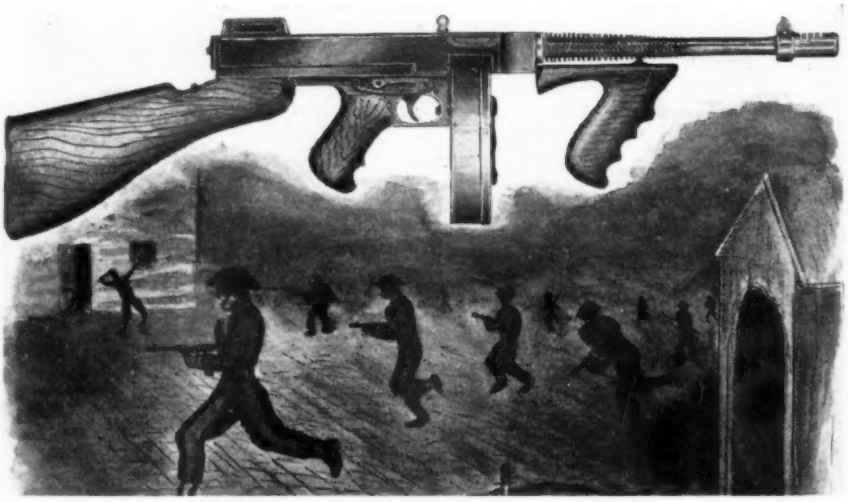
The submachine gun's growth had been stunted in infancy when it was lost under the icebox of confusion and outmoded ideas, and the rejuvenation of the world's armies and their tactics revealed an immense need for mechanical improvement.

Spain's civil war provided a field for exploring the military potentialities of the submachine gun. Germany was the first to make this exploration, and the modernization of the Wehrmacht also brought about the modernization of the submachine gun. In 1938, the Germans lifted it from military obscurity by adopting the Schmeisser machine pistol 38.

The MP 38 was the first weapon to possess all the characteristics, including the all-important feature of cheap mass production, of the modern submachine gun. This simple, blowback-operated weapon was a streamlined version of the old Bergmann, identical in action but completely different in external appearance. Neat and compact, it introduced, in place of the conventional rifle-type wooden stock, the folding metal stock which was developed for use by parachute troops.

In 1940 the German blitzkrieg culminated with the collapse of France and the British debacle at Dunkerque, and formal warfare between armies ended at least temporarily. It became a "gangster's war," to which the "gangster's gun" was eminently suited. England, expecting an invasion, was prepared to fight "in the houses and in the streets."

Street fighting means hot, sudden combat at close quarters, involving snap firing at fleeting targets—definitely a warfare of small groups and individuals.



The Thompson Submachine Gun.

Mr. Gans is a talented young writer and inventor, possessing unusual knowledge of arms.

The employment of regular team weapons in such combat is always difficult and frequently impossible because light machine guns and automatic rifles are incapable of quickly shifting their fire. Also, ammunition carriers with their loads were ill-fitted for the close and vicious nature of house-to-house fighting.

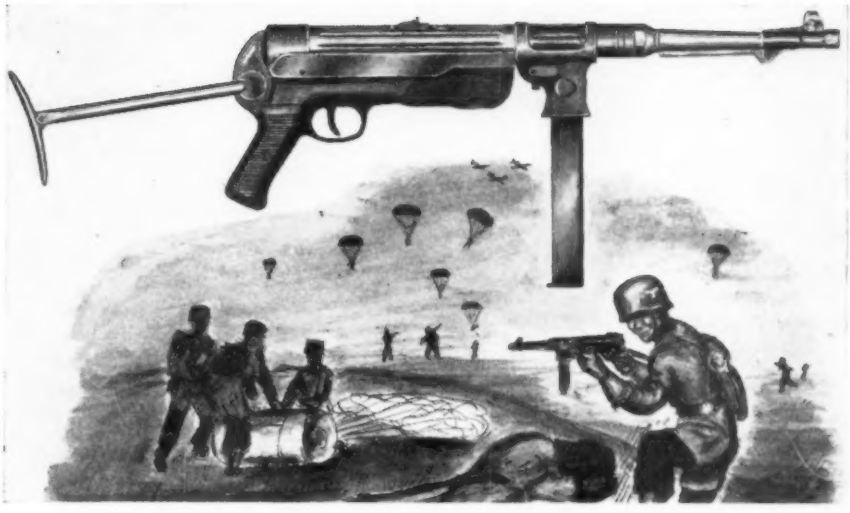
The fire of the manually operated or semiautomatic rifle was in itself insufficient, but it was very effective when augmented by the volume of fire of the submachine gun. Its essential characteristics made the submachine gun ideal for small warfare because, since it is an individual weapon like the rifle, its compactness made it more maneuverable at close quarters than a bulkier arm.

A large number of rounds was immediately available in the gun's magazine, and, by changing magazines, the gunner could remain in action when other weapons had expended their ammunition. Also, because the employment of small-size pistol cartridges permitted him to carry ammunition proportionate to his firepower, he could carry on a little war all his own. Consequently, Great Britain purchased and manufactured in its own factories huge numbers of Thompson submachine guns.

Blitzkrieg had also demonstrated that warfare, when finally resumed, was to be a high-speed, fluid-front war of specialists. Artillerymen, truck drivers, mechanics, and ordnancemen who, in the days of static trench warfare, had been safe behind relatively fixed lines, now, even if their army were on the offensive, would be constantly exposed to swiftly moving spearheads of enemy forces, roving reconnaissance elements, and the sudden attacks of descending air-borne units. So they required small, convenient dispensers of intense emergency firepower for self-protection at very short notice.

The pistol was inadequate, and the rifle was too cumbersome for specialists and too limited in firepower. The advantages of the German distribution of Schmeissers among specialists were instantly obvious.

The United States Army began searching for an appropriate weapon to replace the pistol and rifle in the rear echelons. Although the Thompson submachine gun was employed to a certain extent, the Army decided that its value did not compensate for its inaccuracy at ranges over 150 yards and poor penetration except against personnel almost entirely exposed to fire.



The Schmeisser Machine Pistol, MP 38.

The caliber .45 bullet has great stopping power within its limits, but a weapon called upon to reply to the fire of offensive arms had to have a greater range than 150 yards. The nominal effective range of guns firing 9-mm. Luger pistol cartridges was 300 yards, although firing at targets over 100 yards away with any submachine gun of the time was sheer optimism.

It was held that an arm with a pistol's limited ballistic qualities could not justify its weight (the Thompson weighed more than the M1 rifle) except for special uses. Moreover, the Thompson was cocked with an open breech, and pressing the trigger caused the massive bolt to rush forward before each shot, jarring the weapon and making accurate semiautomatic fire virtually impossible.

Something in between was required —a weapon like a rifle with the convenience of a pistol. The compromise was found in the lightness and compactness of the M1 semiautomatic carbine, a new miniature version of the M1 rifle, whose newly developed cartridge was powerful enough to give its blunt-nosed bullet adequate stopping power within 300 yards.

Thus, the United States Army, with its tremendous supporting industries, could afford to use semiautomatic carbines as well as submachine guns for the same purpose. The Germans and the British, however, relied solely upon submachine guns for protective armament.

But the very features which made the tommy gun efficient defensively made it valuable on the offense. The "gangster's gun" was very successful in the British employment of "gangster's tactics"—the Commando raid. Troops participating in such hazardous types of operations had to move with lightning speed and hit hard, and they required assault weapons which supplied heavy yet extremely mobile and flexible firepower. This type of raid was greatly similar to the German air-borne operations which had already proved the worth of the submachine gun.

TOMMY guns were therefore liberally distributed throughout Commando units, contributing substantially to their effectiveness. The Russians later proved both the defensive and offensive value of this weapon. England was not invaded, but Russia was, and the Russians fought in the houses and in the streets, using submachine guns with telling effect.

Later, carrying the offensive abilities to tremendous lengths on a general scale by completely arming entire units, often as large as battalions, with tommy guns, they demonstrated the devastating effect, both physical and psychological, of such concentrations of fire. German veterans will readily corroborate.

Dunkerque robbed the British Army of almost all its weapons, even light arms, and England was desperate for guns. Many Thompson guns were bought from America, but the Thompson was an expensive weapon, and its manufacture was not easily adaptable to the already heavily overtaxed British industry. The answer to this crisis was the Sten gun—the "Woolworth Gun"—a

The Bergmann Machine Pistol, MP 18.I.

crudely finished piece of junk which cost only eight dollars but whose performance equaled those of the more expensive weapons of its class.

ORIGINALLY intended as an expendable stopgap weapon, it was found so satisfactory that it remained a standard arm of the Army and Local Defense Volunteers (Home Guard). Considerable numbers were also smuggled and parachuted to saboteurs and guerrillas in German-occupied territory.

The first few years of the war having provided the submachine gun with a wide variety of field use, such controversial subjects as type of fire could at last be fully discussed. In the submachine gun's infancy it had been held inadvisable to complicate its mechanism with a selector to allow semiautomatic fire.

Some years ago, a foreign military attaché stationed in Washington told the author of early experiments with semiautomatic devices in the standard machine pistol of his country. "The results did not seem to be in proportion to the complication," he said, "and it was seldom used. A trained man can easily come down to one- or two-shot volleys without any mechanical aid."

References to the Thompson have already indicated that a gun cocked with its breech open was constantly jarred by the forward slap of the bolt, and it was claimed that open-breech cocking was necessary to prevent the possibility of spontaneous ignition of a round held in a heated chamber. Since it was considered incapable of any great accuracy and was a weapon of "firepower" anyway, it would have seemed that change-over mechanisms were a waste of time, energy, and materials.

This was a visualization of the submachine gun as a bullet-squirter whose primary purpose was to spray lead indiscriminately, but its rôle was later more thoroughly understood. It was actually a weapon of opportunity, whose "firepower"—an often-used but seldom-explained term—was certainly not a mere capacity for burning up ammunition. More accurately, it was its ability to administer as much *well-placed* fire as possible. With its fully automatic capacity available to furnish a reserve of fire, the tommy gun gave its most satisfactory performance when used semiautomatically, as a rifle—bursts being resorted to only for use in the critical phases of action.

It must be remembered that cyclic rate and accuracy were anything but coequal concepts. Very intensive fire could be maintained and a thousand rounds discharged, but without accurate aiming this shower of lead was absolutely wasted. When bursts were too long, the line of fire inevitably swerved, resulting in diminishing accuracy. Firing therefore had to be frequent and exact.

The interval necessary to change magazines was also valuable in allowing a cooling period for the soldier as well as for the gun. These points were proved by the Reising submachine gun, an arm able to fire semiautomatically and cocked with its breech closed, which was used in action by U. S. Marines.

It is difficult to say how much further development of the submachine gun would have gone had not the war ended when it did, but changes were making a trend obvious.

The use of rifle ammunition in the submachine gun would have been impossible without making it an automatic rifle. Since the effectiveness of such an arm would have depended upon a continuous ammunition supply, others besides the gunner would have been absorbed into the service of the piece which then would have lost its flexibility and independence.

The required weapon had to be completely self-contained and capable of delivering full firepower from the hands of one man. It had to be small, compact, and light so that a large quantity of ammunition could be easily transported by the gunner.

The dimensions of the cartridge always governed the ammunition factor, necessitating the use of less-effective pistol ammunition. The British stepped up the cartridge load, increasing the range of the Sten gun—which was modified to make it sturdier—and let it go at that. The Germans, however, could not use the machine pistol, for its ammunition supply was already extended to the limit. Their move was to develop an intermediate cartridge—one between pistol and rifle ammunition.

Some time later the U. S. Army found that for close-in automatic-weapons' support it was necessary to have a weapon with greater range and penetration than the submachine gun, but with greater mobility and flexibility than the automatic rifle and light machine gun. To attain sufficient ballistics qualities, at the same time remaining an individual arm, the weapon required an intermediate cartridge, like the German compromise between the two contradictory qualifications.

But the answer to the ammunition problem already existed in the combination of features which made the caliber .30 M1 carbine cartridge ideal.

The weapon problem was easily solved, too, because the M1 semiautomatic carbine was easily adaptable to full-automatic fire.

A Tribute to Great Americans

Generals Crowell, Eaker, and Mitchell Attend a Meeting

Louis B. Seltzer

Editor, the Cleveland Press, from an editorial of June 5, 1946

PERHAPS not another soul among the thousand men and women saw him.

But Ben Crowell, I am sure, saw him.

They had just honored Ben Crowell for his valiant service in two wars. The Army Ordnance Association in the Rainbow Room of Hotel Carter had given him a gold medal.

There had been many fine tributes.

Now Lieut. Gen. Ira Eaker, deputy commander of the Army Air Forces, was talking.

Ben Crowell sat, a hand cupped to an ear, listening intently.

"We will not have," said the great genius of the famous Eighth Air Force, "the factors of time and distance on our side."

It was here, it seemed, that one who could not be seen by any but Ben Crowell, came back for just one earthly moment from wherever he is to place a gentle hand on Ben Crowell's shoulder.

"Friend Ben," the presence might have said to Ben Crowell. "Listen well, for he, too, has come back from another of our country's wars, as I did. He, too, brings back a lesson for the future. Listen well—listen, and persuade others to listen, better than they did to me."

And General Eaker went on to say, "We must reorganize our national defensive structure for the new type of warfare. Our national defense is not three problems, of Air, Army, and Navy. It is one, and should be organized as one."

Ben Crowell leaned forward yet more intently, as if the presence at his hand was saying, "Remember, friend Ben, when I, too, said that. Remember when I said that for the next war our national defense should be reorganized, that we had obsolete methods, antiquated equipment, that all of our military air forces should be organized into one department under one control."

"Yes," it could be imagined Ben Crowell answered, "and you were court-martialed and disgraced because you dared to say these things to your countrymen."

And General Eaker went on, "Any sensible person in reading the signs and signals of the world today should at least be prepared for another war at some time. The next war will be a different war, and we must not only make our weapons modern, but our thinking modern."

Ben Crowell nodded, it seemed in agreement both with what General Eaker had said and with what the presence was also saying:

"If only they had listened, friend Ben, when we were urging our country to prepare for the next war with modern weapons and modern thinking, how many lives would have been saved, how much suffering would have been spared, how much more effective would the United States of America have been during the war and in winning the peace that right now seems so difficult."

"Yes," it again could be imagined Ben Crowell was saying, "if they had only listened to you, instead of punishing you for your courageous and visionary foresight."

And General Eaker, quiet, earnest, choosing his words carefully and expressing them convincingly, hit hard time and time again at the urgent need for modernizing our national defense, making it into one, and keeping the fire of preparedness in a confused and distorted world burning so that we might not again make the same mistake made twice before.

At last General Eaker finished, and Ben Crowell relaxed, smiling his approval at the courage of this new general of the Air Forces—this 1946 version of his, Ben Crowell's great friend, "Fighting Billy" Mitchell, who in 1925, after the first World War, was court-martialed for daring to say then what General Eaker said in substance at the Hotel Carter.

The reason I am sure that Ben Crowell saw him yesterday noon when perhaps no other among the thousand men and women saw him, was because of what Ben Crowell and General Billy Mitchell said in Ben Crowell's home in Cleveland the year he was court-martialed.

"Wherever I go, Billy, I will always think of what you have sacrificed for the good of your country, your personal security, your future, your everything," said Ben Crowell. "I will always remember that you have proved yourself not alone a great soldier in battle but a great patriot in peace. I will always see and hear you."

So, perhaps not another soul among the thousand men and women saw him. But Ben Crowell, I am sure, saw him.

And Ben Crowell, seeing him, sensing his presence at his side, must, finally, have said to himself:

"You made it possible, Billy, for General Eaker and all the others in the Army, the Navy, the Marines, the Air Forces to speak out plainly and courageously without fear of court-martial, because you did that, and were court-martialed. Your country has lived to learn how wrong your critics were about you and does not ever again wish to be wrong about another."

Somehow, for Ben Crowell that meeting yesterday must have meant not only honor to himself for what he did for his country but, even more important for Ben Crowell, honor and vindication for his good friend "Fighting Billy" Mitchell who in 1936 went quietly into the other world where wars among men are never fought.

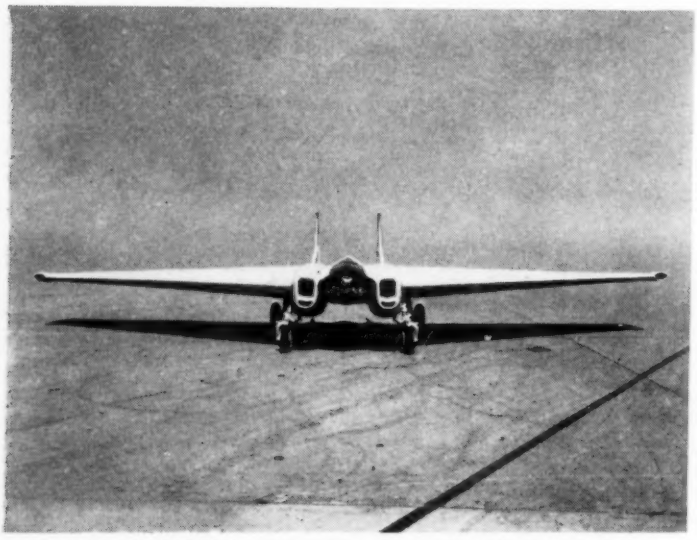
New American Aircraft

The V-173 is a prototype of new Navy experimental fighters of radical design permitting operation at very high and low speeds.

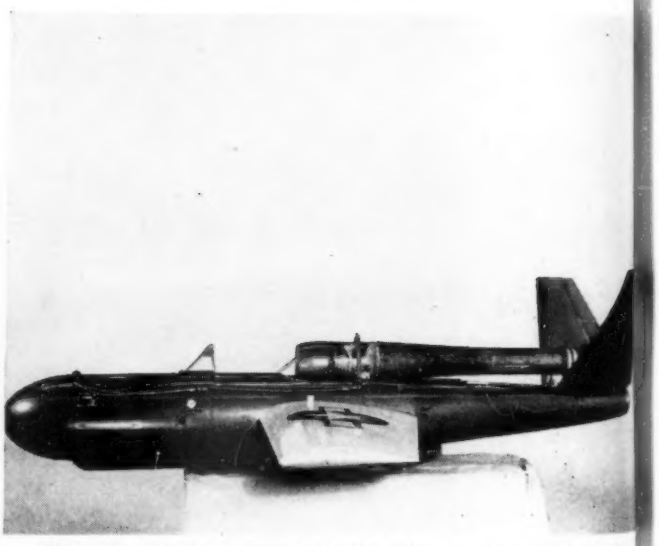
The Douglas-built XB-43 is America's first jet-propelled bombe In test flights its performance matched that of fighter

With speeds of from 40 to 425 m.p.h. the XF5U-1 is the latest development of the V-173. Note clean lines (Navy photos).

The buglike "eyes" of the XB-43 house the pilots, givi clean, sleek lines that permit speeds in excess of 500 m.p.



The Army's XP-79 incorporates many unique features. It is a jet-propelled "flying wing" and is piloted from a prone position.



This tiny pilotless aircraft is the Navy's jet-propelled dron designed as an aërial target for fighter planes (Navy photo

ARMY ORDNANCE

Combined with FIREPOWER, *the Ordnanceman's Journal*

Published Bimonthly by

THE ARMY ORDNANCE ASSOCIATION
WASHINGTON, D. C.

Col. J. L. Walsh, Founder and Editor, 1920-1922
Brig. Gen. R. H. Somers, Editor, 1922-1925
Maj. Gen. R. L. Maxwell, Editor, 1925-1926
Col. C. R. Baxter, Editor, 1926-1929
Col. Leo A. Codd, Editor, 1929-1942
Brig. Gen. R. H. Somers, Editor, 1942-1944

Editor: Leo A. Codd
Managing Editor: R. E. Lewis
Editorial Staff: H. P. Hill, M. L. Van Horn, J. J. O'Connor

ARMY ORDNANCE, the journal of the Army Ordnance Association, has no official or semiofficial governmental status. All statements expressed in the articles, editorials, and advertisements are those of the authors, editors, and advertisers and do not represent official War Department policy.

SEPTEMBER-OCTOBER, 1946

Month by Month

The President's Evaluation Board for the Atomic Bomb Tests submitted a preliminary report of the test held at Bikini Atoll on July 1, 1946, which will do much to crystallize our thinking about the A-bomb. Dr. Karl T. Compton is chairman of the board and Bradley Dewey, deputy chairman. The Navy is represented on the Board by Rear Adm. W. R. Purnell and Rear Adm. R. A. Ofstie. The other civilian member is Thomas F. Farrell, while the Army is represented by Gen. Joseph W. Stilwell and Lieut. Gen. Lewis H. Brereton. Here are the principal findings of the board:

The members of the board inspected target ships the day before the test, witnessed the explosion from an airplane twenty miles distant, and then approached to within nine miles of the atoll for a brief view. On the following day, as soon as safety clearance had been received, the members flew to Bikini and began their examination of ship damage. Many photographs have been studied, and military and scientific specialists interviewed in an attempt to obtain an over-all understanding of test results prior to the compilation of all the data.

From its previous study of the plans for the test and from its observations in the Bikini area the board considers that the test was well conceived and executed by the services in close coöperation with a large civilian staff. It is satisfied that the conditions of the test were well chosen and that the highest skill and ingenuity have been used to obtain a maximum amount of data in an unbiased, scientific manner. It believes that the commander, staff, and personnel of Task Force One deserve high commendation for their excellent performance and their notable coöperative spirit.

Effective precautions appear to have been taken to safeguard personnel against radioactivity and associated dangers.

The board's present information is that the bomb exploded, with an intensity which approached the best of the 3 previous atomic bombs, over a point 1,500 to 2,000 feet westerly of the assigned target and at approximately the planned altitude.

The target array in no sense represented an actual naval disposition but was designed to obtain the maximum data from a single explosion.

The most important effects produced by the bomb are the following:

a. A destroyer and two transports sank promptly and another destroyer capsized. It later sank, and the Japanese cruiser SAKAWA sank the following day. The superstructure of the submarine SKATE was so badly damaged as to make it unsafe to submerge the vessel. The light carrier INDEPENDENCE was badly wrecked by the explosion, gutted by fire, and further damaged by internal explosions of low order, including those of torpedoes. All the above vessels were within a half mile of the explosion point.

b. Numerous fires were started on other ships, including one on a ship two miles distant, which was apparently due to some unusual circumstance since the other fires were much closer. Here it should be remembered that the target ship decks carried a great variety of test material not ordinarily exposed on the decks of naval vessels.

c. The only major combatant ships within a half mile of the explosion point were the battleships NEVADA and ARKANSAS and the heavy cruiser PENSACOLA. The blast struck these from the after quarter. Apparently little damage was done to their hulls or their main turrets, but their superstructures were badly wrecked. These ships were unquestionably put out of action and would, along with many others within three-fourths of a mile, have required extensive repairs at a principal naval base.

d. Other ships in the target array suffered damage in varying degree, depending on position and type of ship, but there was relatively little damage at distances greater than three-fourths of a mile.

e. The primary material effects noted were due to blast, causing the buckling of decks and bulkheads and the destruction or deformation of lightly constructed exposed objects, including stacks, masts, and antennas.

Secondary effects were due to fire, and it is noteworthy that Army Quartermaster stores and miscellaneous equipment placed on the decks for the test proved more vulnerable than normal naval deck gear.

It should be pointed out that since the targets carried no personnel the fires were uncontrolled and undoubtedly there was more damage than there would have been under battle conditions. Singularly, although considerable amounts of explosive ordnance were exposed on decks and in gun turrets, there is no indication on ships which remained afloat that

any of this material was exploded by direct action of the atomic bomb.

Fire-fighting ships entered the target area as soon as they could obtain radiological security permission and subdued a number of fires. The speed and efficiency with which these ships acted preserved for later examination a great deal of evidence of bomb action which might otherwise have been lost.

f. Examination of the flash-burn effects produced by the initial radiation from the explosion indicates that casualties would have been high among exposed personnel. However, it is the opinion of the board that persons sheltered within the hull of a ship or even on deck in the shadow of radiation from the bomb would not have been immediately incapacitated by burns alone, whatever might have been the subsequent radiological effects.

g. Within the area of extensive blast damage to ship superstructures there is evidence that personnel within the ships would have been exposed to a lethal dosage of radiological effects.

Personnel casualties due to blast would no doubt have been high for those in exposed positions on vessels within a half mile of the target center. Beyond this, any discussion of the blast effect upon personnel will have to await the detailed reports of the medical specialists.

In general, no significant unexpected phenomena occurred, although the test was designed to cope with considerable variation from predictions. There was no large water wave formed. The radioactive residue dissipated in the manner expected. No damage occurred on Bikini Island, about three miles from the explosion center.

From what it has seen and from what it has ascertained from data now available, the board is able to make certain general observations:

a. The atomic bomb dropped at Bikini damaged more ships than have ever before been damaged by a single explosion.

b. The test has provided adequate data of a sort necessary for the redesign of naval vessels to minimize damage to superstructures and deck personnel from this type of bomb. Because of the nature of the first test (air burst) little information has been obtained on hull effects. Damage to ships' hulls will be studied specifically in the second test when a bomb will be exploded under water.

The President's Commission also reported on the first atom-bomb test. This committee consisted of Senator Carl A. Hatch of New Mexico, chairman, and the following members: Senator Leverett Saltonstall, Massachusetts; Representative Chet Holifield, California; Representative Walter G. Andrews, New York; Edward U. Condon, director, U. S. Bureau of Standards, Washington, D. C.; Karl T. Compton, president, Massachusetts Institute of Technology, Cambridge, Mass.; Bradley Dewey, Cambridge, Mass.; William S. Newell, Bath, Maine; Fred Searls, New York, N. Y. Its principal conclusions were expressed as follows:

There were ninety targets anchored in the lagoon when the bomb exploded. These were not in battle formation but were placed in positions to give the largest amount of desired technical information with especially close concentration around the center target point. Those ships anchored a mile or more from the point of drop largely escaped injury. Those within a mile were sunk or suffered damage varying with the distance from the point of detonation and with the type of ship construction.

Following the explosion, a destroyer and two transports sank promptly. A second destroyer and the Japanese cruiser SAKAWA sank within twenty-seven hours. The light carrier INDEPENDENCE was gutted with fire and resultant explosions. The submarine SKATE was heavily damaged and was later towed away.

All these were near the point of explosion. The other ships, including the only two capital ships which were within a half mile of the detonation, received damage that would require more or less complete overhaul and in most cases repair at major bases before they could again be used for combat. A study of this damage will point the way to changes in design which should minimize damage from blast and heat.

Further from these ships there was extensive damage to superstructure, radar, and fire control. Had the ships within the damage area been manned, casualties and psychological injuries would have required a large percentage of replacements. Until the readings of complex instruments and the future life history of animals within the ships have been determined, no accurate appraisal of potential damage to humans within the ships can be made.

No wave or blast damage could be noticed on Bikini Island, which is approximately three miles from the point of detonation.

More than two years ago, the Army Ordnance Association appointed a board, under the chairmanship of Col. William W. Coleman, then vice-president of the Association, to prepare a statement of basic principles on the postwar national-defense organization. The Coleman Board urged, and during the past two years the Association has continually urged, the establishment of "an Armed Services Staff College as the apex of a defense training system which should include all elements necessary to train the Armed Forces of the Regular Service and the Reserve in strategy, tactics, and logistics."

We are happy to report that this recommendation of the Association has finally been approved by the War and Navy Departments, and that an Armed Forces Staff College will be established in January 1947 at Norfolk, Va. The college will train selected Army-Navy-Air officers in joint operations.

The new institution will be under the jurisdiction of the Joint Chiefs of Staff with the Chief of Naval Operations responsible for its operation and maintenance. The scope of instruction will include orientation, organization, characteristics, and employment of Army, Navy, and Air Forces in relation to one another; the study of joint staff techniques and procedures; the preparation of plans for amphibious and airborne operations involving the employment of joint forces; and also the study of the organization, composition, and functions of theater and joint task forces and the responsibilities (strategical, tactical, and logistical) of the commanders thereof.

There will be approximately 150 students in each class, divided about equally among the Army, Navy, and Air Forces. The course will last five months and is indicative of the present wide-awake attitude of top-echelon Army-Navy-Air personnel in matters pertaining to national preparedness.

Atomic Explosives

An Editorial

TWO of the major hurdles in the path of atomic energy have been cleared: The principal Bikini tests have been held and reported upon, the national policy for the control of atomic energy has been written into the law of the land. The green light for the application of atomic energy to peaceful uses awaits only the further tests to be held at Bikini and the adoption of an international policy regarding its control. On the latter question, the report of Mr. Bernard M. Baruch, as described elsewhere in this issue, seems to us to be the sane and sound answer. Mr. Baruch has long been noted for the right answers to most questions connected with our national defense.

¶ The Bikini tests were not as world-startling as many scientists had foretold. The tests were conducted with superb precision and planning, reflecting great credit upon all concerned and especially upon Vice Adm. W. H. P. Blandy. It was a fine example of the courage of the American Navy which, having won the hard battles of the Pacific War, was not afraid to face the implications as well as the physical damage of the atomic bomb in Bikini Atoll, even though the target ships were unable to maneuver or fight back. The several committees —the President's Evaluation Committee under the chairmanship of Dr. Karl T. Compton, and the Joint Chiefs of Staffs Evaluation Board under the chairmanship of Senator Carl A. Hatch—have described and commented upon these historic details.

¶ Our national policy, as now contained in United States statutes, bespeaks a constructive attitude toward the utilization of atomic energy for peacetime pursuits as well as the safeguarding of the military phases of atomic explosives for use as weapons. Nuclear fission, radioactivity, and the other allied advances in the realm of physics foreshadow an application of these forces in the fields of medicine and mechanics which may open vast vistas for the welfare of humanity. It would have been preposterous even to attempt to throttle such application under the guise of military necessity. It would have been equally tragic to have cast aside the military controls which are a part of the value of atomic energy in so far as it is a weapon.

¶ Now we can get down to work and apply atomic energy in both fields of activity on a national scale. There is no doubt, of course, that we are in possession of a new explosive which dwarfs all its predecessors. It is equally certain that we are in possession of an agent which has its limitations. New techniques of offense and defense will be required, new forms of weapons using atomic energy will be necessary, new types of vehicles and new types of ships afloat and aloft will be essential during the next decade. The older forms will fast give place to this newcomer. The progress of warfare has always been so from the beginning.

¶ Let us hope we are correct in saying that the period of hysteria about atomic bombs has now passed and that we are prepared to face the problems of our national defense with the realism and simplicity their proper solution demands. Meantime, we will do well to restore our man power and munitions-producing power to the efficiency required by world affairs. We have undone some of the damage wrought to our national defense by the war of nerves after Hiroshima and Nagasaki. Beginning at Bikini, we can build our ramparts in conformity with modern science which has armed our fighting men with a new superweapon. Later on, when atomic energy is fully explored, maybe we can reduce the size and composition of our armies, navies, and air fleets. But not now.

Association Affairs

MISSION ACCOMPLISHED

When the Williams Gold Medal was presented to Brig. Gen. Benedict Crowell at Cleveland two months ago, a stirring scene was witnessed by the more than 600 members and guests who were present. The editorial tribute from the *Cleveland Press*, published on page 173 of this issue, is indicative of the depth of feeling the ceremony aroused.

Presiding at the meeting was Ward Canaday, chairman, Willys-Overland Motors, Inc., and president of the Cleveland Post, A.O.A. In attendance were civic leaders of Ohio and Cleveland, as well as ranking officers of the armed forces. Ohio was represented by its governor, Hon. Frank J. Lausche; Cleveland by its mayor, Hon. Thomas A. Burke; the Ordnance Department by Maj. Gen. Everett S. Hughes, its chief; the Army Air Forces by Lieut. Gen. Ira C. Eaker, its Chief of Air Staff; and the Army Ground Forces by Maj. Gen. Willard G. Wyman. All paid tribute to the medalist.

The appreciation of the members of the Army Ordnance Association for more than twenty-five years of outstanding service was expressed in the citation, accompanying the award, prepared by the special committee consisting of James L. Walsh, New York, N. Y., chairman; K. T. Keller, Detroit, Mich.; and L. A. Codd, Washington, D. C., members. The citation which follows was read by Colonel Walsh:

"*Whereas* Brig. Gen. Benedict Crowell of Cleveland, Ohio, after more than a quarter of a century of devoted service as president of the Army Ordnance Association, has felt impelled to submit his resignation from that high office, and

"*Whereas* the Board of Directors of the Army Ordnance Association, in meeting assembled at Aberdeen Proving Ground, Md., on April 4, 1946, with keen regret for the necessity of this action, have accepted General Crowell's resignation, it is hereby

"*Resolved* that the Board of Directors, voicing the conviction and sentiments of the entire membership of approximately 45,000 American scientists, engineers, industrialists, and military leaders, hereby spreads upon the record its sincere appreciation of the unequaled achievements in practical patriotism of General Crowell, its first president.

"When the Ordnance Officers' Reserve Corps was first authorized in 1916, Benedict Crowell was one of the first to offer his services to our country. Shortly before war was thrust upon the United States on April 6, 1917, he was commissioned in the rank of major and was called to active duty immediately. Soon thereafter he was selected by President Woodrow Wilson as the Assistant Secretary of War, and later as Director of Munitions. He served in this dual capacity with outstanding fidelity and ability throughout the first World War and during the period of demobilization until his resignation June 30, 1920. Fortuitously, he then became available for office in the newly organized Army Ordnance Association, to the presidency of which he was unanimously elected. Since his inauguration he has served the interests of the Association, the Ordnance Department and the Nation, with rare courage, loyalty, and judgment.

"With the advent of peace in 1919, General Crowell took a leading part in the studies and recommendations which materialized in the National Defense Act of 1920. This Act became the charter of industrial preparedness in the United States and has stood the tests of time in peace and war with added laurels to those whose wisdom and foresight brought it into being twenty-six years ago.

"For nearly twenty-six years, in war and in peace, in times of martial enthusiasm and pacifist apathy, General Crowell has held steadfast in his loyalty to scientific and industrial preparedness as being our strongest guaranty of peace—and assurance of quick victory if war should unhappily be thrust upon us again.

"With the advent of World War II, General Crowell was promptly requested by the then Secretary of War to serve on his personal staff as a consultant. This he did with his usual willingness, devoting a great portion of his time throughout the war to service in this important field.

"His unique record of farsighted patriotism is written in actions which through the years have shortened the duration of combat and thus saved countless fine young American lives.

"In further tribute to his phenomenal record of patriotic service, the Williams Gold Medal, established in honor of Maj. Gen. C. C. Williams, Chief of Ordnance, 1918-1930, has been awarded to General Crowell by the Army Ordnance Association as a symbol of our gratitude, respect, and admiration for a great citizen who has served his country faithfully and well."

PEACETIME PREPAREDNESS: Plans for Industrial Mobilization for War

The Army Ordnance Association, together with the Aircraft Industries Association and the Navy Industrial Association, is busily at work on industrial-mobilization plans in coöperation with the Army and Navy Munitions Board. Richard R. Deupree, president of Procter & Gamble Company, Cincinnati, Ohio, is chairman of that all-important board which, under the National Defense Act of 1920, is responsible for the over-all peacetime preparation of plans for industrial mobilization in time of war. A number of studies are presently being prepared looking toward the solution of more urgent problems in this broad field.

The work of the Board was brought to national prominence on June 19th at a conference with President Truman in the White House. In attendance were civilian and military experts and representatives of the three above-named organizations which are closely affiliated with industrial preparedness. Col. Frederick H. Payne, vice-president of the Army Ordnance Association, who was the Assistant Secretary of War in the cabinet of President Hoover, represented the A.O.A. at the White House conference. Eugene E. Wilson, president of the Navy Industrial Association, and LaMotte T. Cohu, president of Aircraft Industries Association, were also in attendance, as were Vice Adm. Edward L. Cochrane, Chief of the Bureau of Ships, U. S. Navy; Maj. Gen. Everett S. Hughes, Chief of Ordnance, U. S. Army; and Maj. Gen. Edward M. Powers, Assistant Chief of Air Staff for Supply, Army Air Forces.

The Board has a task which demands the utmost understanding and coöperation on the part of science, industry, and the American people as a whole. No window-dressing organization, the Board deals in the stern realities which face our economy in time of major war. Mr. Deupree, in bringing the work of the Board to the attention of the President at this time, has charted a course which requires complete understanding on the part of all our people if another major war is to be won without the tragic losses and mistakes of World War II.

Vast importance is attached to the preparation of plans and studies relating to the supply of Ordnance matériel in time of war. It is a well-known fact that there is no peacetime industry

as such for the production of ordnance in the United States, and there is little likelihood that such an industry, if it came into being, would ever be desirable.

Similarly, too great emphasis cannot be placed upon the fact that the Army Ordnance Association is not a "trade" association. Therefore it does not have available statistical data covering the ever-changing production capacities of American industry as they may relate to the products and component parts as well as the processes ultimately used in ordnance manufacture. The A.O.A. is a society of individuals and groups which in the aggregate comprise a vast reservoir of technical skills and facilities, the utilization of which is dependent upon the types and quantities of equipment which are required in time of war.

Determination of both the types and quantities of military equipment needed by our fighting forces in time of war are basic considerations, and these data reside primarily and in most cases exclusively in the hands of governmental agencies rather than in those of private industry. The Army Ordnance Association can bring to the Board outstanding advice and assistance from men and organizations who, by experience gained in time of war, have together accumulated vast amounts of technological and production-engineering information. Through such means the work of the Board and of the Army Ordnance Association can be coördinated to the advantage of our national defense.

FIRST COUNCIL MEETING: In Accordance With New Constitution and By-Laws

In conformity with the new constitution and by-laws of the Army Ordnance Association, the newly established Council will hold its first meeting for the election of directors in Washington, October 2, 1946.

Council, under the new constitution, is composed of one member elected for a period of one year (or until his successor is chosen) by and representing each Post, the immediate past president, the present charter national officers and charter national directors for life, and fifteen members at large to be elected for a period of one year by the Council. The charter officers and directors of the Association eligible to serve as members of Council for life are: William W. Coleman, Bucyrus-Erie Company, Milwaukee, Wis., former vice-president and now president; Benedict Crowell, Central National Bank, Cleveland, Ohio, former president; Robert P. Lamont, former Secretary of Commerce, New York, N. Y., director; Samuel McRoberts, former chief, New York Ordnance District, New York, N. Y., director; Frank A. Scott, former chairman, War Industries Board, Cleveland, Ohio, director; and James L. Walsh, editor of LOGISTICS, New York, N. Y., director.

Members of Council chosen to represent their respective local Posts are:

Charles D. Ammon, Cushman Motor Works, Lincoln, Nebr.—Nebraska Post;

James H. Burns, former member, Munitions Assignments Board, Combined Chiefs of Staff, Washington, D. C.—Washington Post;

Ward M. Canaday, Willys-Overland Motors, Inc., Toledo, Ohio—Cleveland Post;

Harry Darby, the Darby Corporation, Kansas City, Kans.—Midwest Post;

Edward B. Gallaher, Clover Manufacturing Company, Norwalk, Conn.—Hartford-Springfield Post;

Herbert A. Gidney, Gulf Oil Corporation, Pittsburgh, Pa.—Pittsburgh Post;

R. E. Gillmor, Sperry Gyroscope Company, New York, N. Y.—New York Post;

Ralph F. Gow, Norton Company, Worcester, Mass.—Boston Post;

J. E. Kanaley, Campbell, Wyant & Cannon Foundry Company, Bettendorf, Iowa—Quad Cities-Iowa Post;

Fairman B. Lee, Fairman B. Lee Company, Seattle, Wash.—Puget Sound Post;

Edwin B. Meissner, St. Louis Car Company, St. Louis, Mo.—St. Louis Post;

Luther S. Oakes, Winston Brothers Company, Minneapolis, Minn.—Northwest Post;

Allen Rushton, former assistant chief, Birmingham Ordnance District—Birmingham Post;

Ralph Cook Scott, former commanding officer, Umatilla Ordnance Depot, Oreg.—Los Angeles Post;

Frank J. Smith, John P. Smith Company, Inc., Rochester, N. Y.—Empire Post;

Dean Witter, Dean Witter & Company, San Francisco, Calif.—San Francisco Post; and

S. H. Woods, Research Center, Aberdeen Proving Ground, Md.—Aberdeen Proving Ground Post.

In the absence of specific designation, the following presidents of local Posts will serve as members of Council until their successors are elected:

A. J. Armstrong, Texasteel Manufacturing Company, Fort Worth, Tex.—Lone Star Post;

W. W. Coleman, Bucyrus-Erie Company, South Milwaukee, Wis.—Milwaukee Post;

R. S. F. DeMent, Red River Ordnance Depot, Texarkana, Tex.—Red River Post;

C. W. Dupuis, Central Trust Company, Cincinnati, Ohio—Cincinnati Post;

Edward T. Gusheé, Detroit-Edison Company, Detroit, Mich.—Michigan Post;

T. S. Hammond, former chief, Chicago Ordnance District—Chicago Post;

Frank Hinderliter, Hinderliter Tool Company, Tulsa, Okla.—Mid-Continent Post;

C. Jared Ingersoll, former chief, Philadelphia Ordnance District—Philadelphia Post;

Ross Stewart, C. Jim Stewart & Stevenson, Houston, Tex.—Texas Post;

L. P. Weiner, former member, Chicago Ordnance District's Advisory Board—Central-Illinois Post; and

Henry A. Winter, Winter-Weiss Company, Denver, Colo.—Rocky Mountain Post.

In compliance with provisions of the new Constitution, fifteen members of Council at large have been invited by the president of the Association to serve, as follows:

Frank B. Bell, Edgewater Steel Company, Pittsburgh, Pa.;

Harry A. Bullis, General Mills, Inc., Minneapolis, Minn.;

C. K. Davis, Remington Arms Company, Bridgeport, Conn., chairman, Artillery Industry Division Committee;

Arthur G. Drefs, McQuay-Norris Company, St. Louis, Mo.;

John M. Hancock, Lehman Brothers, New York, N. Y.;

Arnold Hanger, Silas Mason Company, New York, N. Y., member, Artillery Ammunition Division Committee;

Stanley C. Hope, Gilbert & Barker Manufacturing Company, West Springfield, Mass., chairman, Fire Control Industry Division Committee;

William S. Knudsen, General Motors Corporation, Detroit, Mich.;

K. T. Norris, Norris Stamping and Manufacturing Company, Los Angeles, Calif., member, Artillery Ammunition Division Committee;

Walter Pew, Sun Oil Company, Philadelphia, Pa.;

Charles M. Pond, Pratt & Whitney, West Hartford, Conn., chairman, Gage Division Committee;

Fred A. Preston, Poor & Company, Chicago, Ill.;

H. M. Tillinghast, R. Hoe & Company, New York, N. Y., chairman, Committee on Coöperation with Other Organizations;

J. E. Trainer, Firestone Tire & Rubber Company, Akron, Ohio, chairman, Artillery Industry Division Committee; and

Thomas J. Watson, International Business Machines Corporation, New York, N. Y., member, Small Arms Ammunition Division Committee.

ORDNANCE BOOK SERVICE: A.O.A. Offers New Opportunity to Members

One more advantage is being added to the many others that go with membership in the Army Ordnance Association—and it will afford opportunities for further individual savings. Members will be able to read the best literature at a substantial saving. Which is to say that the Ordnance Book Service, exclusively for members of the A.O.A., is about to be inaugurated.

The Ordnance Book Service will comprise two main features. There will be an Ordnance Book of the Month which will be recommended by the editors of ARMY ORDNANCE and announced in our monthly INDUSTRIAL PREPAREDNESS BULLETIN. By ordering the book of the month from A.O.A. headquarters, members will save at least fifteen per cent of the standard published price. Remittances must accompany all orders to national headquarters, and orders will be accepted only from members in good standing.

In addition, the Ordnance Book Service will recommend to members periodically lists of selected books on military, economic, historical, and sociological subjects, as well as current fiction. On these recommended books similar savings up to fifteen per cent of the standard price will also be available to members.

In addition, the Ordnance Book Service is prepared to obtain for members any book now in print and to do so at a saving to the purchaser, the exact amount to depend upon the individual case, in any event, at a saving. It is the hope of the editors of this magazine that members will make generous use of this additional membership service.

ORDNANCEMEN'S PROFESSIONAL SERVICE: A.O.A. Efforts Successful

Immediately following V-E Day, the Army Ordnance Association established its Ordnancemen's Professional Service to assist all Ordnance personnel—men and women, military and civilian—to obtain placement in suitable private employment. Members of the A.O.A. can look with pride upon the record of this activity.

The Ordnancemen's Professional Service is unique in that it has none of the earmarks of the usual employment service. It uses no questionnaires, compiles few statistics, and makes no charge to any one—either prospective employer or employee. Its one purpose has always been to help the returned service men and women and at the same time to assist science, industry, and commerce in obtaining the skills of these highly trained Ordnance personnel.

Those who served in Ordnance—Army, Navy, and Air—in World War II are a highly capable group. Military rank has little or nothing to do with the indication of individual skills. As the Selective Service System operated in the recent war, men and women of outstanding capabilities not only served in the soldier and noncommissioned officer grades but many, due to group assignments to military duties, were not utilized to their maximum efficiency. The reason why in the majority of cases is not far to seek, as modern wars are still fought by infantrymen and artillerymen. When war strikes, the professional man as well as the common laborer must take his assignment as it comes.

Now that nearly all personnel have returned to civilian life, in the future the Service will be restricted to members of the Army Ordnance Association. In the past, as a public aid in the general interest there has been no limitation whatever upon users of this service. National headquarters will continue to help all members locate the right man for the right job and the other way around.

GENERAL ARMSTRONG RETIRES: Joins Staff of American Standards Association

Brig. Gen. Donald Armstrong, who has just retired from the Army after thirty-six years of service, has joined the staff of the American Standards Association. General Armstrong will assist the chairman of the A.S.A. executive committee in expanding and developing the activities of the A.S.A. His work will deal particularly with the enlarged responsibilities which the Policy Committee on Standards, under the chairmanship of Charles E. Wilson, agreed the American Standards Association should undertake.

General Armstrong's experience in the Ordnance Department as chief of maintenance, Office of the Chief of Ordnance; as executive officer and chief of the Chicago Ordnance District; and as commanding general of the Ordnance Replacement Training Center, Aberdeen Proving Ground, Md., gives him an exceptionally fine background for the association.

From 1924 to 1926, General Armstrong was on duty in the testing laboratory at Watertown Arsenal in Ordnance research and development. In his Ordnance work he became keenly aware of the importance of standards and of the savings in time and material that the use of standard specifications made possible.

As commandant of the Industrial College of the Armed Forces he has helped to emphasize the importance and value of standardization for a more effective and less costly industrial mobilization.

NECROLOGY

A. Thornton Lewis was recently awarded posthumously the War Department Citation and Decoration for Exceptional Services in connection with critical Ordnance procurement and conversion programs.

Thornton Lewis, who served during the early war years on the staff of Brig. Gen. Hermon F. Safford, chief of the Production Division, Office of the Chief of Ordnance, died July 4, 1945, shortly after his retirement which was prompted by failing health. Through 1944, and to the time of his retirement in November of that year, he was associated with Brig. Gen. D. N. Hauseman, chief, Army Service Forces' Readjustment Division. The award was on the basis of his highly successful organization and coordination of a conservative program of critical Ordnance materials, and "his comprehensive understanding of the problems of mass production, and the proper conservation, utilization, and allocation of raw materials which contributed immeasurably to the success of the Ordnance production control program."

Lieut. Col. W. George Devens, chief of Ordnance chemical survey section, Office of the Director of Service Supply and Procurement, War Department General Staff, died at the Pentagon in Washington, D. C., July 12, 1946. He was long identified with the Army Ordnance Association, of which he had been an active member for many years.

A native of Beacon, N. Y., Colonel Devens was a graduate of the United States Naval Academy. Shortly after his graduation he transferred to the Army and was commissioned a second lieutenant in the Coast Artillery in 1924. He was assistant professor of Ordnance at the United States Military Academy in West Point from 1938 to 1941. During the war he was commanding officer of the Rossford Ordnance Depot at Toledo, Ohio, and prior to his death he served as a member of the War Department General Staff at the Pentagon.

NOTICE has also been received of the deaths of the following members of the Association: P. E. Booth, Indianapolis, Ind.; A. G. Carlson, Clifton, N. J.; Charles Diehl, Ridgefield, N. J.; E. L. Ferguson, Cleveland, Ohio; W. J. George, Pittsburgh, Pa.; R. L. Gordon, New York, N. Y.; R. L. Hill, Wilmington, Del.; C. J. Holslag, Newark, N. J.; M. R. Kempton, Michigan City, Ind.; Ivar Lundgaard, Rochester, N. Y.; E. M. Lyons, Detroit, Mich.; J. H. Sundmaker, North Olmstead, Ohio; Dr. Maximilian Toch, New York, N. Y.; and S. W. Utley, Detroit, Mich. To their relatives and friends, ARMY ORDNANCE, on behalf of the Association membership, extends condolences.

Let's look ourselves over

By E. B. Gallaher

This is the second article of a series being written for ARMY ORDNANCE *by Mr. Gallaher, noted business analyst. Others will follow regularly.*—EDITOR.

Increased Labor Efficiency?—We speak loosely of increased labor efficiency and have come to believe that, as time advances, the average worker becomes more and more efficient and, therefore, is entitled to more pay. It is probably a fact that over the last hundred years the average worker, *per se*, has been getting less and less efficient—not more efficient. There are, of course, exceptions.

A hundred years ago a skilled worker received about ten cents an hour for his work, and he had to be really skilled to earn it since he worked without the help of machine tools and the few hand tools he had were of the crudest type. Fifty years ago a journeyman machinist earned thirty cents an hour, but he had a variety of machine tools to work with.

Today, in view of the fact that the skilled worker receives 1,500 per cent more than he did a hundred years ago, can any one really believe that the worker of today could, due to his own personal increase in efficiency, produce 1,500 per cent more than the worker of a hundred years ago? Of course this is absurd; so why keep talking of the workers' increased efficiency?

The fact is that a hundred years ago the total investment in plant, tools, and equipment per worker was only $550. Most of this was in plant as there was little equipment and few tools—the latter being mostly hand tools.

Today, by placing in the hands of the worker modern plants, assembly lines, an enormous variety of equipment, machine tools, automatic machines, jigs and fixtures, etc., in which industry and capital have had to invest, on an average, $7,000 for each worker, the workers who have been taught to operate these tools can produce with them 1,500 per cent more than they could without them.

As a matter of fact, it requires much less skill to operate a modern machine tool than it does to produce a marketable product by hand work. The modern factory worker would find it practically impossible to produce anything without the use of modern tools.

We may be certain that our workers are not going to increase their efficiency and produce enough to pay for the increase in wages that our Government has awarded them. They couldn't do it if they wanted to.

The only way we can hope to get more production from a worker is to place in his hands additional equipment, new methods, more highly efficient tools, automatic machines, and new techniques, so that the machine he operates will produce more in relation to the wages he receives.

The Danger of Price Raising.—The raising of prices to cover increased costs must be considered only as a temporary measure, because higher prices simply mean that the dollar is being depreciated. Such a condition cannot last for long for buyers' strikes will occur and our entire economy will be disrupted. As a matter of fact, mild buyers' strikes have already made an appearance and will grow in intensity.

If every one in the country was employed at the excessive prevailing wages being received by members of unions, raising prices to cover increased costs, plus a suitable profit margin, would be quite in order. The increased wages would buy the same amount of high-priced goods, and we all would receive the same amount of goods and services as we used to receive in normal times before the purchasing power of the dollar was curtailed. The only difference would be that we would now pay about two dollars for a dollar's worth of goods out of our jacked-up two dollars of wages.

In other words, we always get the same amount of goods and services in return for a given effort or amount of work on our part. It will make no difference whether we get the legitimate wage or twice the legitimate wage because the prices we must pay for goods and services will be adjusted to the rate of pay we receive. Our standard of living would therefore remain the same. Why, then, do buyers' strikes occur?

Unfortunately, the vast majority of the 40,000,000 workers in the country don't get these increased wages. Their pay checks have remained about the same as they were when a dollar would buy a dollar's worth of goods and services. Now they find that, due to the greed of the unions, the prices of goods must be raised to cover the increased cost of production, and their dollar will now only buy about sixty cents' worth of goods and will probably buy less by the end of the year.

These people also find that the interest they received before the war on securities and on their savings will now only buy half as much as it used to, so naturally they are becoming alarmed.

High prices are acceptable to the man who is getting increased wages. They are acceptable to the manufacturer or merchant who is forced to pay excessive prices for materials and labor. By adding his margin of profit based on these increased costs and raising his selling price he would then receive enough to maintain himself in an inflated market. But when the rest of us can't participate in this inflation and obtain enough additional cheap money to buy the necessities of life, something is bound to happen.

There are about 100,000,000 people in this position today. The majority are living from hand to mouth, many with no savings, a few with very meager savings, and a very few, about 10 per cent, with fairly substantial savings.

These people are already beginning to question present inflated prices. A buyers' strike has already begun to develop, and when it really gets under way a crash will occur that will bring prices and wages tumbling down to ultimately restore the buying power of the dollar.

Industry, if it is wise, will employ every means it possesses to mechanize its operations to the limit, and to do so quickly. Studies should be made of every operation with a view to making it automatic if possible. But, in any event, labor costs should be reduced to the minimum through the use of new methods, new types of machines, new process, and modern techniques.

Generally speaking, costs can be materially reduced if each operation is analyzed and new and better methods devised. We have no time to lose. The only salvation will be the capacity to produce cheaply when the crash of present high prices comes, an event closer at hand than is presently suspected. A fully mechanized plant has nothing to fear when it is forced to reduce prices since it will be able to manufacture profitably in spite of the fluctuation of costs.

Prices will probably drop before wages are reduced as was the case following World War I. A schedule of mechanization must be charted in time to enable us to produce profitably with present material and labor costs, in order to be able to lower the selling prices of our products when we are forced to do so.

Later, after the break in prices has occurred, a period of unemployment will probably develop as industries adjust themselves to the new conditions. Then the cost of labor will probably be lowered, as workers will be bidding for available jobs. When this second period is reached, industry, which in the meantime has become highly mechanized, will realize higher profits, not alone from its mechanization but also from a reduced cost of both labor and materials. Again we can refer to a similar condition which developed during the 'twenties.

In this particular period after the first World War, industry had everything its own way. It exacted extremely high prices

for its products. It was highly mechanized, it paid high wages for the men it needed, it made enormous profits, and it greatly inflated its overhead with high salaries, etc., to cover up its earnings. But at the same time millions were unemployed.

At this point, industry failed to realize that it was only one step from the master's bedroom to the doghouse. Instead of reducing its inflated overhead to within reason and reducing prices to ensure greatly increased distribution, thereby providing more jobs for the unemployed, executives began gambling—issuing dividends to cover up enormous earnings. Finally the bubble burst in 1929, and our whole economy collapsed. The people then took hold—elected Roosevelt and the socialistic New Deal; the politicians took over, put industry in the doghouse, and began to run our affairs for us.

There will probably be an excellent demand for manufactured products until the first of 1947, provided that prices are not increased to a point that will produce active sales resistance or provide incentive for a new wave of strikes.

During these next few months industry should strive to produce in volume and sell at no more than just enough to cover the cost of production plus a very reasonable profit. While doing this, it should intensify its efforts to mechanize its operations highly so as to be in position to pay present labor and material costs for as long as necessary and be able to sell its products at prewar prices and still make an adequate profit. This, in most cases, can be done, though the time is growing very short.

When the collapse comes, as it surely will, management will be forced to reduce prices to about prewar levels. Material costs will go down first, then labor costs will follow a few months to possibly a year later. This will be the dangerous period for industry, for if at that time its inventories are inflated, if its costs of production have remained high, if it has been depending upon increased selling prices to cover increased costs of operations, then it is likely to get into serious trouble.

If, on the other hand, it can mechanize to sufficient extent before the collapse comes so that it can absorb the present high costs of labor and materials and still sell at a profit, then industry will be in position to take advantage of present higher selling prices while they last. Then reduction of prices to meet competition later on can be effected without causing serious financial difficulties.

Communism Is with Us.—The fight in Congress over OPA is not to settle the question as to how much prices should be advanced or how much profit a manufacturer or merchant should be allowed to make. It is of much more fundamental significance.

Certain control of prices during this postwar period would have been desired, provided that both wages and costs had been held in line from the outset and the whole job properly administered.

Unfortunately, Communists had intermingled with New Dealers and believed an opportunity had presented itself whereby they could acquire control of the industry of our country through the medium of the OPA's war powers. If it had not been for the straight thinking of a small group in our Congress, they might very well have succeeded, since the Administration has been weak and willing.

The major question before the Nation today is this: Do we desire to continue in our American tradition of free enterprise or do we wish to go Socialistic or Communistic?

It must be one or the other. These doctrines do not mix any better than oil and water, nor can we have a free economy with a touch of Communism.

The reason for injecting this subject here is that it serves as a reminder that industry must be careful not to do things that would offer a platform for Communistic propaganda as it did in the 'twenties.

E. B. Gallaher

Ordnance Directory

A Record of Industrial Achievement—Part II

F. W. Foster Gleason

THIS is the second installment of a series presenting a directory of the Ordnance establishments extant as of August 14, 1945—V-J Day. Following the completion of the geographical list a glossary of ordnance terms will be published.—EDITOR.

MISSISSIPPI ORDNANCE PLANT—Jackson, Miss. Bag-loading plant. *Operator:* Goodyear Engineering Corp.

MISSOURI ORDNANCE WORKS—Louisiana, Mo. Ammonia. *Operator:* Hercules Powder Co.

MORGANTOWN ORDNANCE WORKS—Morgantown, W. Va. Ammonia, hexamine, formaldehyde, and methanol. *Operator:* E. I. Du Pont de Nemours & Co.

MOUNT RAINIER ORDNANCE DEPOT—Tacoma, Wash. General supplies.

MUNCIE REGIONAL OFFICE—Johnson Building, Muncie, Ind.

NANSEMOND ORDNANCE DEPOT—Portsmouth, Va. Ammunition storage.

NAVAJO ORDNANCE DEPOT—Flagstaff, Ariz. Ammunition storage.

NEBRASKA ORDNANCE PLANT—Fremont, Nebr. Loading plant: bombs, boosters. *Operator:* Nebraska Defense Corp.

NEW CUMBERLAND ASF DEPOT—Ordnance Section—New Cumberland, Pa. Ammunition and general supplies.

NEW RIVER ORDNANCE PLANT—Radford, Va. Bag and igniter loading; flash reducers. *Operator:* Hercules Powder Co.

NEW YORK ORDNANCE DISTRICT—80 Broadway, New York, N. Y.

NEW YORK ORDNANCE WORKS—Syracuse, N. Y. *Operator:* National Aniline Defense Corp.

OGDEN ARSENAL—Ogden, Utah. Ammunition and general supply storage.

OHIO RIVER ORDNANCE WORKS—Henderson, Ky. Ammonia. *Operator:* Atmospheric Nitrogen Corp.

OKLAHOMA ORDNANCE WORKS—Tulsa, Okla. TNT demolition blocks, NS, and smokeless powder. *Operator:* E. I. Du Pont de Nemours & Co.

OMAHA REGIONAL OFFICE—109 South Tenth Street, Omaha, Nebr.

ORDNANCE AUTOMOTIVE SCHOOL—Fort Crook Ordnance Depot, Fort Crook, Nebr.

ORDNANCE AUTOMOTIVE SCHOOL—Mt. Rainier Ordnance Depot, Tacoma, Wash.

ORDNANCE AUTOMOTIVE SCHOOL—Atlanta Ordnance Depot, Atlanta, Ga.

ORDNANCE BOMB DISPOSAL CENTER—Aberdeen Proving Ground, Md.

ORDNANCE AMMUNITION RENOVATION SCHOOL—Delaware Ordnance Depot—Pedricktown, N. J.

ORDNANCE RESEARCH AND DEVELOPMENT CENTER—Aberdeen Proving Ground, Md.

ORDNANCE SCHOOL—Aberdeen Proving Ground, Md.

ORDNANCE TRAINING CENTER—Atlanta Ordnance Depot, Atlanta, Ga.

ORDNANCE UNIT TRAINING CENTER—Red River Ordnance Depot, Texarkana, Tex.

OTTAWA REGIONAL OFFICE—Ottawa, Canada. (*Cont. on p. 184.*)

We are adequately staffed and equipped to serve you on problems of mechanical, chemical, and electrical development. We invite your investigation of our record.

FEDERAL LABORATORIES, INC.
Post-Office Box 268 PITTSBURGH 30, PA.

In The Bendix-Weiss Rolling Ball Universal Joint

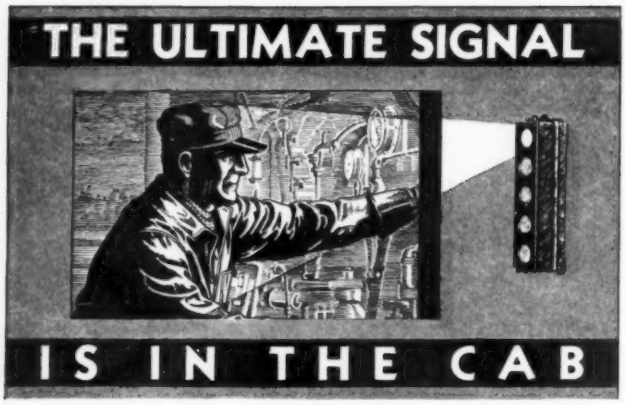
Here Shown Disassembled

STROM BALLS *Serve the Armed Forces*

Here, in the Bendix-Weiss Constant Velocity Universal Joint, Strom Balls do their part in making military vehicles, from Jeeps to 14-ton Armored Cars, the efficient fighting equipment that they are. This is only one spot in our military and civil production where the high degree of perfection of Strom Balls serves industry, enabling it to provide the finest bearing equipment for every military requirement. Strom Steel Ball Company, 1850 S. 54th Ave., Cicero 50, Ill.

Largest Independent and Exclusive Metal Ball Manufacturer

Strom BALLS Serve Industry



G-R-S Cab Signals give the engineman continuous automatic block indications in the cab. They allow him to make immediate response to a change in block conditions which saves time and affords the ultimate in signal protection.

Cab Signals, like all G-R-S Systems, were developed in the interests of providing protection, effecting economical operation by reducing delays, maintaining schedules, increasing track capacity, and lowering train mile costs.

Other G-R-S Systems:

Automatic Block Signaling	Highway Crossing Protection
Automatic Interlocking	Interlocking Consolidations
Centralized Traffic Control	NX (Entrance-Exit) Interlocking
Electric Car Retarders	Remote Control

All G-R-S Systems are Self-Liquidating.

GENERAL RAILWAY SIGNAL COMPANY
ROCHESTER, N. Y.

It was a matter of pride to us to produce the *best* in fulfilling war contracts. It is a matter of pride to us to serve you *best* in peacetime now that we have returned to manufacture of our prewar products in new and improved designs.

MUNCIE GEAR WORKS, INC.
Muncie, Indiana
Manufacturers of Neptune Outboard Motors and Master Stokers

Ordnance Directory

OZARK ORDNANCE WORKS—El Dorado, Ark. Ammonia and ammonium nitrate. *Operator:* Lion Chemical Corp.

PALMER-WOODS ORDNANCE DEPOT—Detroit, Mich. General supplies.

PANTEX ORDNANCE PLANT—Amarillo, Tex. Loading plant: bombs, shells. *Operator:* Certain-Teed Products Co.

PHILADELPHIA AMMUNITION SUPPLY OFFICE—904 Chestnut Street, Philadelphia, Pa. (Ammunition Supply Division, Field Service).

PHILADELPHIA ORDNANCE DISTRICT—Philadelphia, Pa.

PHILADELPHIA REGIONAL OFFICE—1420 Walnut St., Philadelphia, Pa.

PICATINNY ARSENAL—Dover, N. J. Smokeless powder, high explosives, and ammunition loading.

PITTSBURGH ORDNANCE DISTRICT—1202 Chamber of Commerce Building, Pittsburgh, Pa.

PLUM BROOK ORDNANCE WORKS—Sandusky, Ohio. DNT, TNT, pentolite. *Operator:* Trojan Powder Co.

PORTAGE ORDNANCE DEPOT (Unit of Ravenna Ordnance Center)—Apco, Ohio. Ammunition storage. *Operator:* Atlas Powder Co.

PORTLAND REGIONAL OFFICE—602 Bedell Building, 520 SW Sixth Avenue, Portland, Oreg.

PUEBLO ORDNANCE DEPOT—Pueblo, Colo. General supplies and ammunition storage.

QUAD CITIES REGIONAL OFFICE—Davenport, Iowa.

RADFORD ORDNANCE WORKS—Radford, Va. Pentolite, double-base powder, smokeless powder, and oleum. *Operator:* Hercules Powder Co.

RARITAN ARSENAL—Metuchen, N. J. General supplies and ammunition storage.

RAVENNA ORDNANCE CENTER—Apco, Ohio. (Includes Portage Ordnance Depot and Ravenna Ordnance Plant.)

RAVENNA ORDNANCE PLANT (Unit Ravenna Ordnance Center)—Apco, Ohio. Loading: Shells, boosters, primers, percussion elements. *Operator:* Atlas Powder Co.

RED RIVER ORDNANCE DEPOT—Texarkana, Tex. General supplies and ammunition storage.

REDSTONE ARSENAL—Huntsville, Ala. Demolition blocks, bursters, chemical shells, grenades.

RESEARCH AND DEVELOPMENT SERVICE SUBOFFICE (AMMUNITION)—Jefferson Proving Ground, Madison, Ind.

RESEARCH AND DEVELOPMENT SERVICE SUBOFFICE (AMMUNITION)—Wright Field, Dayton, Ohio.

RESEARCH AND DEVELOPMENT SERVICE SUBOFFICE (EXECUTIVE)—Aberdeen Proving Ground, Md.

RESEARCH AND DEVELOPMENT SERVICE SUBOFFICE (EXECUTIVE)—1420 Walnut Street, Philadelphia, Pa.

RESEARCH AND DEVELOPMENT SERVICE SUBOFFICE (ROCKET)—Cumberland, Md.

RESEARCH AND DEVELOPMENT SERVICE SUBOFFICE (ROCKET)—Dover, Del.

RESEARCH AND DEVELOPMENT SERVICE SUBOFFICE (ROCKET)—California Institute of Technology, Pasadena, Calif.

RICHMOND REGIONAL OFFICE—Reynolds Metals Building, Richmond, Va.

RICHMOND TANK DEPOT—1414 South Tenth Street, Richmond, Calif. *Contractor:* Ford Motor Co.

ROCHESTER ORDNANCE DISTRICT—1242 Mercantile Building, Rochester, N. Y.

ROCK ISLAND ARSENAL (Unit of Rock Island Ordnance Center)—Rock Island, Ill. Gun carriages and recoil mechanisms.

ROCK ISLAND ORDNANCE CENTER—Rock Island, Ill. (Includes Rock Island Arsenal, Rock Island Ordnance Depot, Field Service Suboffice.)

ROCK ISLAND ORDNANCE DEPOT (Unit of Rock Island Ordnance Center)—Rock Island, Ill. Gun-carriage and combat-vehicle storage.

(Continued on p. 186.)

Producers of SULPHUR

Large stocks carried at all times, permitting prompt shipments . . . Uniformly high purity of 99½% or better . . . Free of arsenic, selenium and tellurium.

TEXAS GULF SULPHUR CO. INC.
75 E. 45th Street New York 17, N.Y.
Mine: Newgulf, Texas

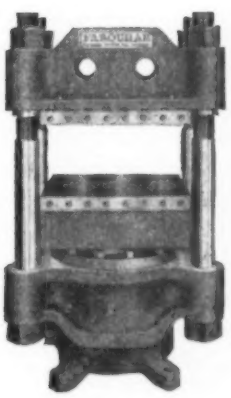
Mission Accomplished . . .

Faster . . . Better . . . At Less Cost with

Farquhar HYDRAULIC PRESSES

No matter how large or small your operation may be, **Farquhar**, builders of hydraulic presses with capacities of 3 in 7200 tons, can solve your problems . . . serve you efficiently and economically.

Farquhar builds the press you need. Illustrated at the right is a Farquhar Hydraulic Production Press equipped with a steel steam platen. This press is built in a variety of sizes to meet the production requirements of your shop. Remember, Farquhar builds the press you need.



1856 NINETIETH ANNIVERSARY YEAR 1946
A. B. FARQUHAR COMPANY
1507 DUKE STREET YORK, PENNSYLVANIA

McCord
IS PROUD TO SERVE **YOU**
Who Serve Our Country

McCord is producing for America's Armed Forces on land, on sea and in the air. In addition McCord regular lines of radiators, gaskets, lubricators and heat transfer surface are being supplied for the Army, the Navy and essential civilian use.

McCORD CORPORATION
GENERAL OFFICES, ENGINEERING AND LABORATORIES
DETROIT 11, MICHIGAN

PHILCO
CORPORATION

★ ★ ★

PHILCO RADIOS
PHILCO RADIO-PHONOGRAPHS
PHILCO TRANSITONE RADIOS
PHILCO AUTO RADIOS
PHILCO FARM RADIOS
PHILCO REFRIGERATORS
PHILCO-YORK AIR CONDITIONERS
PHILCO POWER BATTERIES
PHILCO DRY BATTERIES
PHILCO RADIO TUBES
PHILCO REPLACEMENT PARTS

★ ★ ★

See them at
YOUR PHILCO DEALER'S

Ordnance Directory

ROSSFORD ORDNANCE DEPOT—Toledo, Ohio. General supplies. *Operator:* Harvester War Depot, Inc. (International Harvester Co.)

SAFETY AND SECURITY DIVISION, OFFICE CHIEF OF ORDNANCE—333 North Michigan Avenue, Chicago, Ill.

SAGINAW REGIONAL OFFICE—Goff Building, Saginaw, Mich.

ST. LOUIS ORDNANCE DISTRICT—3663 Lindell Boulevard, St. Louis, Mo.

ST. LOUIS ORDNANCE PLANT—St. Louis, Mo. Small-arms ammunition. *Operator:* U. S. Cartridge Co.

ST. LOUIS ORDNANCE DEPOT—St. Louis, Mo. General supplies.

ST. LOUIS REGIONAL OFFICE—1116 Arcade Bldg., 812 Olive St., St. Louis, Mo.

SALT LAKE BRANCH, OGDEN ARSENAL—Salt Lake City, Utah. Matériel return center.

SAN FRANCISCO ORDNANCE DISTRICT—100 McAllister Street, San Francisco, Calif.

SAN ANTONIO ARSENAL—San Antonio, Tex. Ammunition and general supplies storage.

SAN FRANCISCO REGIONAL OFFICE—417 Montgomery Street, San Francisco, Calif.

SANGAMON ORDNANCE PLANT—Springfield, Ill. Loading plant: shells, fuzes, boosters. *Operator:* Remington-Rand Co.

SAN JACINTO ORDNANCE DEPOT—Houston, Tex. Ammunition storage.

SAVANNA ORDNANCE DEPOT—Proving Ground, Ill. Ammunition, shell loading, and general supplies.

SAVANNA SECTION, ORDNANCE SCHOOL—Proving Ground, Ill.

SCHENECTADY ASF DEPOT, Ordnance Section—Schenectady, N. Y. Ammunition and general supplies.

SEACOAST AND ANTIAIRCRAFT CARRIAGE SUBOFFICE—Watertown Arsenal, Watertown, Mass. (Artillery Division, Industrial Service.)

SEATTLE REGIONAL OFFICE—517 Arctic Building, Third Avenue and Cherry Street, Seattle, Wash.

SENECA ORDNANCE DEPOT—Romulus, N. Y. General supplies and ammunition storage.

SIERRA ORDNANCE DEPOT—Herlong, Calif. General supplies and ammunition storage.

SIOUX ORDNANCE DEPOT—Sidney, Nebr. General supplies and ammunition storage.

SOUTHWESTERN PROVING GROUND—Hope, Ark. Proof of equipment and ammunition.

SPRINGFIELD ARMORY—Springfield, Mass.

SPRINGFIELD ORDNANCE DEPOT—Springfield, Mass. Small-arms storage.

SPRINGFIELD ORDNANCE DISTRICT—Springfield, Mass.

STOCKTON ORDNANCE DEPOT—Stockton, Calif. Supplies.

SUBMARINE MINE DEPOT—Fort Monroe, Va. Development and manufacture of submarine mines and supplies.

SUNFLOWER ORDNANCE WORKS—Lawrence, Kans. Smokeless powder and oleum. *Operator:* Hercules Powder Co.

SUSQUEHANNA ORDNANCE DEPOT—Williamsport, Pa. Ammunition storage.

SYRACUSE REGIONAL OFFICE—Syracuse-Starret Building, Syracuse, N. Y.

TERRE HAUTE ORDNANCE DEPOT—Terre Haute, Ind. General supplies.

TOLEDO REGIONAL OFFICE—Garner Building, Toledo, Ohio.

TOOELE ORDNANCE DEPOT—Tooele, Utah. General supplies and ammunition storage.

TORONTO BRANCH OFFICE—509 Canadian Pacific Building, Toronto, Canada.

TULSA REGIONAL OFFICE—1002 Hunt Building, Tulsa, Okla.

TWIN CITIES ARSENAL—Minneapolis, Minn. Small-arms ammunition. *Operator:* Federal Cartridge Co.

TWIN CITIES REGIONAL OFFICE—Builders Exchange Building, Minneapolis, Minn.

(*Continued on p. 188.*)

Manufacturers of over 360 different products for home and industry

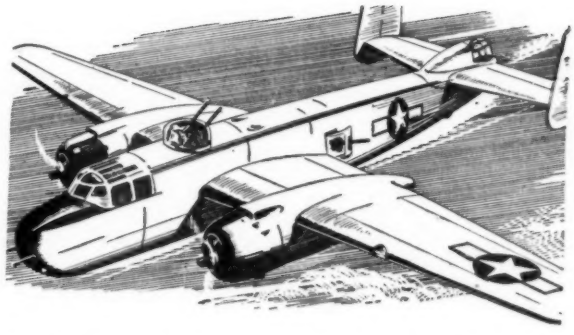
ARMSTRONG CORK COMPANY
MUNITIONS DIVISION
Lancaster, Pennsylvania

THE OLIVER 900

Husky, dependable . . . built for tough heavy jobs, yet easy to handle, flexible in performance, and low in maintenance cost. Ideal power unit for airport, industrial, and construction work. Wide range of operating speeds.

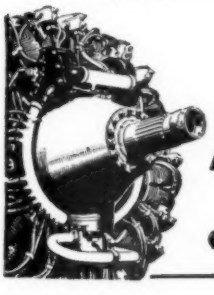
The OLIVER Corporation
400 W. MADISON ST.-CHICAGO 6, ILL.

FINEST IN FARM MACHINERY



North American B-25 Mitchell *with* WRIGHT CYCLONE 14's

First over Tokyo, this medium bomber has led the attack in every theatre of war. In all its varied models — for bombing, strafing, submarine patrol and land or sea attack — the B-25 Mitchell is powered with two Wright Cyclone 14's of 1,700 horsepower each.



WRIGHT
AIRCRAFT ENGINES
DIVISION OF
CURTISS WRIGHT
FIRST IN FLIGHT

THE BUCKEYE STEEL CASTINGS CO.

CAST STEEL RAILWAY PRODUCTS

Producers of
High Grade
Carbon and Alloy Steel Castings
Cast Armor

MAIN OFFICE AND WORKS
Columbus 7, Ohio
NEW YORK CHICAGO

TOKHEIM OIL TANK AND PUMP CO.

FORT WAYNE, INDIANA

✦ ✦

Manufacturers of

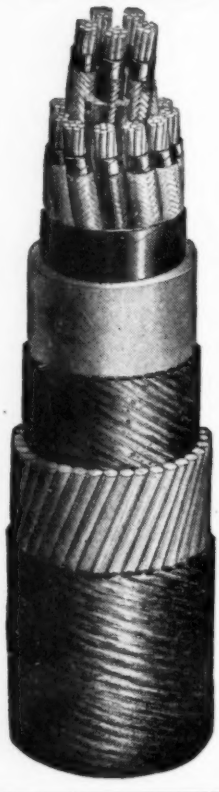
Ammunition Components

and Ordnance Materials

✦ ✦

ALL MANUFACTURED WITH THE TRADITIONAL HIGH QUALITY AND PRECISION FOR WHICH TOKHEIM HAS BEEN FAMOUS FOR OVER 40 YEARS.

CRESCENT



Ability to

Manufacture

WIRES

AND

CABLES

is the result of over

fifty years' experience

CRESCENT

INSULATED

WIRE & CABLE CO.

TRENTON, N. J.

Ordnance Directory

UMATILLA ORDNANCE DEPOT—Ordnance, Oreg. Ammunition storage.

UTAH ASF DEPOT, ORDNANCE SECTION—Ogden, Utah.

VOLUNTEER ORDNANCE WORKS—Chattanooga, Tenn. TNT, oleum. *Operator:* Hercules Powder Co.

WABASH RIVER ORDNANCE WORKS—Newport, Ind. RDX and Compositions B, C-2, and C-3. *Operator:* E. I. Du Pont de Nemours & Co.

WATERTOWN ARSENAL—Watertown, Mass. Gun carriages and forgings.

WATERTOWN ORDNANCE DEPOT—Watertown, Mass. Gun carriage and forging storage.

WATERVLIET ARSENAL—Watervliet, N. Y. Cannon.

WATERVLIET ORDNANCE DEPOT—Watervliet, N. Y. Cannon storage.

WELDON SPRING ORDNANCE WORKS—Weldon Spring, Mo. TNT. *Operator:* Atlas Powder Co.

WEST VIRGINIA ORDNANCE WORKS—Point Pleasant, W. Va. TNT. *Operator:* General Chemical Defense Corp.

WINGATE ORDNANCE DEPOT—Gallup, N. Mex. Ammunition storage.

WHITE SANDS PROVING GROUND—Las Cruces, N. Mex.

WOLF CREEK ORDNANCE PLANT (Unit of Milan Ordnance Center)—Milan, Tenn. Loading plant: armor-piercing ammunition, shells, bomb clusters, bombs, tracers, rockets, fuzes, primers, tetryl pellets. *Operator:* Procter & Gamble Defense Corp.

WORCESTER REGIONAL OFFICE—Worcester, Mass.

YORK REGIONAL OFFICE—York, Pa.

YOUNGSTOWN REGIONAL OFFICE—Youngstown, Ohio.

Geographical Locations of Ordnance Establishments

ALABAMA:
- Alabama Ordnance Works, Sylacauga.
- Anniston Ordnance Depot, Anniston.
- Birmingham Ordnance District, Birmingham.
- Coosa River Ordnance Plant, Talladega.
- Gadsden Ordnance Plant, Gadsden.
- Redstone Arsenal, Huntsville.

ARIZONA:
- Navajo Ordnance Depot, Bellemont.

ARKANSAS:
- Arkansas Ordnance Plant, Jacksonville.
- Maumelle Ordnance Works, Little Rock.
- Ozark Ordnance Works, El Dorado.
- Southwestern Proving Ground, Hope.

CALIFORNIA:
- Benicia Arsenal, Benicia.
- Los Angeles Regional Office, Los Angeles.
- Los Angeles Ordnance Depot, Wilmington.
- Research and Development Service Suboffice (Rocket), Pasadena.
- San Francisco Ordnance District, San Francisco.
- San Francisco Regional Office, San Francisco.
- Sierra Ordnance Depot, Herlong.
- Stockton Ordnance Depot, Stockton.

CANADA:
- Ottawa Regional Office, Ottawa.
- Toronto Branch Office, Toronto.

COLORADO:
- Denver Ordnance Plant, Denver.
- Denver Regional Office, Denver.
- Pueblo Ordnance Depot, Pueblo.

DELAWARE:
- Research and Development Service Suboffice (Rocket), Dover.

(*To be continued in next issue.*)

A. Air supply for ventilation in good weather.
B. Exhaust expels hold air.
C. Cargocaire unit supplies dehumidified air to mix with outside or recirculated air in each hold.
E
C
B
A

Cargocaire Ends Sweat Damage

Cargocaire reduces dewpoint in holds so that sweat cannot form, no matter what the weather. No claim for sweat-damage has ever been made on cargo protected by Cargocaire.

Cargocaire

TAKES IT ACROSS, WITHOUT SWEAT LOSS

CARGOCAIRE ENGINEERING CORPORATION

15 Park Row, New York 7, N. Y. 417 Market St., San Francisco, California

Also London, England and Goteborg, Sweden

A Standard of Quality

The products of Perfex, with an outstanding war record, are now being custom built for many of the famous names in American Industry. They are recognized by users everywhere as a standard of quality . . . unexcelled for efficient performance and lasting service.

AUTOMATIC TEMPERATURE CONTROLS for domestic and industrial heating systems, commercial refrigeration and air-conditioning systems, and automatic controls for domestic appliances.

INDUSTRIAL ENGINE RADIATORS (including oil coolers and inter-coolers) for use on trucks, tractors, Diesel locomotives, and various gas- and Diesel-engine powered industrial equipment.

PERFEX CORPORATION

MILWAUKEE 7, WISCONSIN

Complete facilities for light and heavy machine work including assembly. Hand, drop, and upset forgings. Weldments and sheet steel stampings.

The Balmar Corporation

Woodberry, Baltimore, Md.

Where Accurate Interpretation of the Blueprint is Given Three Dimensional Form

BLAW-KNOX SERVICE

in the manufacture of Ordnance

Steel armor

Gun Mounts

Gun Slides

Gun Carriages

Steel castings of all types

All types of structural steel and plate fabrication

Heavy duty and precision machine work

BLAW-KNOX COMPANY

PITTSBURGH, PA.

ARMY E NAVY

Manufacturers of

Bicycle Parts and Accessories

WALD MANUFACTURING COMPANY

Incorporated

MAYSVILLE KENTUCKY

If your work concerns pressure processing you will be interested in the many advantages H-P-M FASTRAVERSE presses can offer you. At right is illustrated the H-P-M FASTRAVERSE deep sheet metal drawing press, equipped with hydraulic blankholder and die cushion. Other self-contained H-P-M presses include production units for forming, forging, die casting, plastics molding, blocking, laminating, extruding, liquid extraction, powder metallurgy, etc. Write today for more details.
H-P-M
HPM
Self contained "All-Hydraulic"
FASTRAVERSE PRESSES
THE HYDRAULIC PRESS MFG. COMPANY
MOUNT GILEAD, OHIO, U. S. A.

Book Reviews

Review Staff

BRIG. GEN. DONALD ARMSTRONG, *military historian, lecturer, author, Washington, D. C.*

COL. GEORGE S. BRADY, *consulting engineer, author, editor, Washington, D. C.*

F. W. FOSTER GLEASON, *military historian, ordnance analyst, editor, Washington, D. C.*

LIEUT. COL. CALVIN GODDARD, *small-arms authority, Washington, D. C.*

CAPT. MELVIN M. JOHNSON, JR., *automatic arms expert, inventor, author, Boston, Mass.*

BRIG. GEN. R. H. SOMERS, *engineer, ballistician, author, editor, Dover, N. H.*

COL. THOMAS K. VINCENT, *artillerist, engineer, author, Springfield, Mass.*

WORLD WAR II—A CONCISE HISTORY. By Roger W. Shugg and Maj. H. A. De Weerd. Washington: *Infantry Journal*. 538 pp. $3.

THIS book is far above the average of contemporary historical works. Both authors are practical historians, in addition to which their positions are such that they have had full access to important United Nations and Axis documents and to military and naval statistics and data. The text itself had the advantage of being seasoned and developed through use in the War Department Orientation Program.

Unlike most purely historical texts, the book brings out the use and the strengths and weaknesses of various types of armor under varying conditions. One sees, for example, that the Battle of Poland was not merely a battle of tanks as the early newspaper accounts showed it, but rather a development of the old Napoleonic system of envelopment with infantry whose firepower was tremendously increased with machine guns and mortars. Apparently, the tactics of war remain much the same as they have always been, and the military reader will find much of value in a study of the book.—GEORGE S. BRADY.

ELEMENTS OF AMMUNITION. By Maj. Theodore C. Ohart. New York: John Wiley & Sons. 412 pp. $6.

IN a short foreword to this interesting volume, Col. Miles W. Kresge, Ordnance Department, says: "It was realized . . . that the gigantic ammunition program [of World War II] which soon would fall upon the Ordnance Department would require, for its successful prosecution, many hundreds of trained ammunition technicians in the various agencies involved in the program . . . How we wished in those early days for a 'book' that could be handed to these newcomers to study and absorb quickly the essence of what they would need to know to handle their jobs: a book that would answer most of their many questions and leave us free to work on the big task that confronted us. "Elements of Ammunition" is such a book . . . It will not only serve as a basic and invaluable tool for the ordnance engineer but should also prove to be a convenient and definitive source of information for all those, military and civilian, whose work or interests carry them into the maze and complexity of modern ammunition."

The basic features of Major Ohart's work are epitomized in

DISTRIBUTORS

AND

ENGINEERS

Ball • Roller • Thrust Bearings

WHEN YOU THINK OF BEARINGS... THINK OF US

DETROIT BALL BEARING CO.

of MICHIGAN

Detroit • Grand Rapids • Kalamazoo

Saginaw • and Toledo, Ohio

SHEFFIELD

Products and Services

Machine Tools

Micro-form Grinders • Thread and Form Grinders
Gear Chamfering Machines • Gear Burring Machines
Special Purpose Machine Tools

Measuring Instruments

Precisionaires • Visual Gages • Electrigages
Multicheks • Electricheks
Internal and External Thread Checking Instruments
Automatic Gaging Machines

All types of Standard and Special Precision Gages

Contract Services

Design • Manufacture • Dimensional Control Systems
Diemakers • Toolmakers
Precision Parts and Assemblies

chek WITH SHEFFIELD

THE SHEFFIELD CORPORATION

Dayton 1, Ohio, U.S.A.

MACHINE TOOLS • GAGES • MEASURING INSTRUMENTS
CONTRACT SERVICES

PROOF TESTS and PROOF MARKS

By LIEUT. COL. CALVIN GODDARD, Ord. Dept.

Internationally known authority on small arms

The brochure describes in detail the proof marks and practices of British companies, Continental concerns, and United States industrial and military facilities. The text is illustrated with over a hundred cuts showing many of the proof marks used, and a number of descriptive charts are included.

Much of the information in these articles is not obtainable elsewhere. It is now made available to members of the Army Ordnance Association at 20 per cent below the regular price of $1.00.

80¢ each to members of the A.O.A.

Send your request for copies, together with check or money order, to

THE ARMY ORDNANCE ASSOCIATION

705 Mills Building **Washington 6, D. C.**

Exide

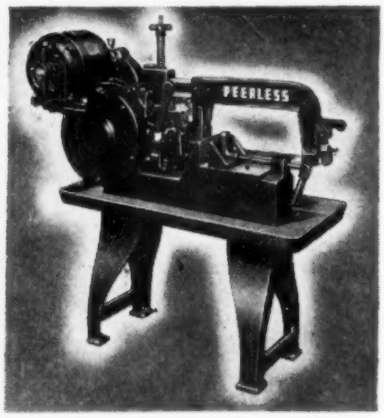
BATTERIES

DEPENDABLE . . . in every storage battery application for over 58 years.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA

Here's the Metal Cutting Saw for Every Use!



PEERLESS 4½" UTILITY . . . *Wet or Dry Cut!*

Ninety strokes per minute on work up to 4½" x 4½" is available with this low-priced Peerless UTILITY model. Blade clears work on every return stroke. Cutting stops automatically at conclusion of operation or can be gauge-set to stop at any point. Made for wet or dry cutting. Used by U. S. Army and Navy. Bulletin U-54 gives complete details. Send for a copy.

PEERLESS
MACHINE COMPANY
RACINE · WISCONSIN

NO OIL
NO WAX
At last . . . a permanent tracing paper . . .
ALBANENE* is made of 100% long fiber pure white rags—treated with *Albanite*—a new synthetic solid, physically and chemically inert. ALBANENE will not oxidize, become brittle or lose transparency with age. ALBANENE has a fine hard "tooth" that takes ink or pencil beautifully, makes tracing simple and produces strong sharp blueprints. Ask your K & E dealer, or write us for brochure and generous working sample.
*Trade Mark
EST. 1867
KEUFFEL & ESSER CO.
NEW YORK—HOBOKEN, N. J.
CHICAGO · ST. LOUIS · SAN FRANCISCO · LOS ANGELES
DETROIT · MONTREAL
K&E Albanene
THE STABILIZED TRACING PAPER

Book Reviews

the remarks of Colonel Kresge, for it is essentially a textbook and definitely not in the category of "light reading." At the same time it avoids entirely any discussion of the chemistry of explosives and includes not overmuch of the mathematics and physics involved in shell and fuze design, etc. Indeed it is extremely readable and packed full of information of timely interest.—CALVIN GODDARD.

THE HISTORY OF DETACHMENT H1 A2. By Edgar B. Walzer. Darmstadt, Germany: J. C. Herbert'sche Buchdruckerei. 95 pp.

THIS beautifully printed, illustrated, and bound book of ninety-five pages is the history of Detachment H1 A2 of the military government forces in Germany under the command of Lieut. Col. Louis G. Kelly. Private Walzer has written a very human document which will have lasting interest not only to the members of the detachment but to all those with whom the organization came in contact in its journeys.

Lou Kelly, the genial commanding officer of the outfit, is a charter member of the Army Ordnance Association. He helped organize the Empire Post of the A.O.A. at Rochester, N. Y., eighteen years ago. His leadership is reflected on every page of this little book which recounts the activities of a strictly American outfit where discipline and good fellowship obtained simultaneously.—L. A. CODD.

STRATEGY IN THE CIVIL WAR. By Barron Deaderick. Harrisburg: The Military Service Publishing Co. 200 pp. $2.50.

AS assistant historian of the Sons of Confederate Veterans, Mr. Deaderick has had access to much private source material, has covered much of the fought-over ground, and has drunk deep of the traditions and atmosphere of the American Civil War. That he has profited well by these opportunities is proved by the amount of concise information and thought-provoking evaluation which he has packed into a volume of but 200 pages.

In his treatment of the eighteen actions considered—ten are in the Eastern theater and eight in the Western—the author makes no pretense of writing anything in the nature of a full account. He concentrates on the strategical aspect, giving but enough of the political motives and tactical movements to point out the reasons for the strategy which is involved.

Much use is made of quotes from American and European authorities, and the author's own comments are commendably objective. Numerous battlefield and regional maps assist the reader, and an appendix which gives a thumbnail sketch of the lives and military records of some fifty Confederate and Union leaders adds considerably to the usefulness of this worthwhile military study.—F. W. FOSTER GLEASON.

A WORLD TO WIN. By Upton Sinclair. New York: Viking Press. 624 pp. $3.

UPTON SINCLAIR is one of our most prolific writers. Several years ago he conceived a series of novels which would form a history of the period from just prior to World War I through World War II. Accordingly, he selected as his chief character one Lanning Prescott Budd. The decidedly picaresque "Lanny" Budd started off just before World War I as a teen-age boy in the first of a series entitled "World's End," followed by "Between Two Worlds," "Dragon's Teeth" (a Pulitzer Prize winner), "Wide Is the Gate," "Presidential Agent," "Dragon Harvest," and now the latest, "A World To Win."

Mr. Lanny Budd is a most ubiquitous individual. He gets around everywhere and manages to see everybody. He is an art expert, but that is only a blind because he is a secret agent for President Roosevelt whom he frequently visits in the late evening when Mr. Roosevelt is sitting in bed wearing a blue crew-neck sweater or a blue cape over his shoulders, poring over the mass

THE development of a production method of heat treating steel cartridge cases to make them provide the "fire power" demanded of them, is typical of the aid to the war effort that has made Norris outstanding.

NORRIS

STAMPING AND MANUFACTURING CO.
LOS ANGELES · CALIFORNIA
SPECIALIST IN THE ART OF METAL DRAWING

MANUFACTURERS
OF A
Complete Line
OF
COTTON GINNING
MACHINERY

☆

CEN-TENNIAL COTTON GIN COMPANY
Branches: DALLAS, TEX., and MEMPHIS, TENN.

THE HARVEY METAL CORPORATION
Engineers and Manufacturers

SMOOTH FORGED
BRASS, COPPER and ALUMINUM

CHICAGO, ILL.

INDEX TO ARMY ORDNANCE, VOLUME XXX

The Index to Volume XXX of ARMY ORDNANCE, with title page for binding, is now ready. It covers subjects in the following 1946 issues: January-February (No. 154), March-April (No. 155), and May-June (No. 156). It is arranged alphabetically by subject and author. Copies may be obtained, free of charge, upon written request.

THE ARMY ORDNANCE ASSOCIATION
705 MILLS BUILDING · WASHINGTON 6, D.C.

CHECK THESE PLUS FEATURES

CUTLER-HAMMER COMBINATION STARTERS
Combining both motor starter and disconnect switch in one convenient unit

- Eutectic alloy overload relay
- Vertical contacts
- Greater accessibility
- Ease of installation
- Increased safety

Write for Bulletin 9589

CUTLER-HAMMER, INC.
315 North 12th Street
Milwaukee 1, Wisconsin

CUTLER-HAMMER MOTOR CONTROL CH

McKAY OFFERS
To ORDNANCE PRODUCERS:

McKAY CHAIN

Welded and Weldless—all sizes and types

McKAY ELECTRODES

For fast, efficient arc-welding in Mild Steel or Stainless Alloy Steels.

McKAY TIRE CHAINS

To provide traction for motorized equipment.

THE McKAY COMPANY
Pittsburgh, Penna.
Sales Offices: York, Penna.

OVER 100 YEARS
SERVICE
IN
EXPLOSIVES

USED IN 1833 AUSTIN EVER SINCE

AUSTIN POWDER CO.
CLEVELAND

of documents which always besieges him. Lanny Budd reports on events in Europe and everywhere else, Mr. Roosevelt cracks a few jokes, and on several occasions Mr. Budd contributes some *bon mots* for speeches later to be made by Mr. Roosevelt.

From the White House or Hyde Park Mr. Budd suddenly transports himself to Germany where he is most intimate with Messrs. Hess, Goering, and Hitler in that order. He buys and sells paintings for Hitler and Goering, and tells Hitler what he thinks Adi wants to hear. In turn, Hitler tells Lanny Budd all his problems, more especially how he hates Russia and how he wishes he did not have to fight England and bomb London.

"A World To Win" is most assuredly an interesting historical novel. It affords not only the pleasure of good reading but a most intriguing background of history and of big-name people.

On the whole, Lanny Budd has been somewhat of a parlor pink, yet at the end of "A World To Win," after he has seen Joe Stalin, he comments on the fact that he hopes Mr. Stalin really means what he says in disclaiming interest in any territories outside of Russia.—MELVIN M. JOHNSON, JR.

WALTHER PISTOLS. By W. H. B. Smith. Harrisburg: Military Service Publishing Company. 94 pp. $2.

MR. SMITH is now so well known to American (and foreign) gun lovers for his outstanding works on small arms that the announcement of a new title over his signature is doubtless tantamount to the advance sale of a very considerable number of copies. And those who order these will be making no mistake, for anything he produces is, based on past performance, worth acquiring sight unseen.

In the present instance he has supplied a most readable account of the development of the 500-year-old arms industry in Zella Mehlis, Germany, home of the Walther plant, and in nearby Suhl—names which immediately conjure up images of fine weapons and exquisite workmanship.

Tracing the history of the Walther plant from its foundation in 1886 to the launching of Walther's first model of automatic pistol in 1909, he proceeds to carry it forward to the time of its occupation by American troops, when an inventory showed no less than 375,000 pistols on hand. Each model developed and marketed during the interval, including some so rare that many enthusiasts have never heard of them, is fully described and illustrated, its characteristics discussed, and its suitability for use with ammunition of high-pressure type outlined when indicated.—CALVIN GODDARD.

BASTOGNE—THE FIRST EIGHT DAYS. By Col. S. L. A. Marshall, assisted by Capt. John G. Westover and Lieut. A. J. Webber. Washington: *Infantry Journal*. 261 pp. $3.

UNQUESTIONABLY, Bastogne captured the public fancy in December 1945. It was a tough battle for those who fought there and was the most important event in the war for those whose sons died there. But in the long range of history it was a small event. As one high-ranking officer expressed it in Washington when the news came through: "The Germans have no place to go, and neither the men nor the equipment to go there."

December 1945, was not May 1940, and the Battle of the Bulge was a foolish effort of a dying organization. Had the Germans broken through into France their army would have been in an untenable position surrounded by immeasurably superior forces and armor.

But the book is the story of the relatively small force of Americans who held out in the center of the Germans against heavy odds. It is presented in modern newspaper style heavily interspersed with the names of officers and men who took part. For that reason it is particularly interesting to the families of those mentioned.

MECHANICAL ENGINEERS
ELECTRICAL ENGINEERS

Experienced Engineers in Armament

Experienced Engineers in Machine Design and Sheet Metal Products

✦

Must Be Able to Do Own Board Work

✦

Have Prewar Successful Background

✦

First Class Only

✦

Write Setting Forth Full Particulars, Places Worked, Projects, Etc.

HARVEY MACHINE CO., INC.
DEPT. LAH
6200 AVALON BLVD. • LOS ANGELES 3, CALIF.

COPPER
BRASS
BRONZE
NICKEL SILVER

AMBRAC* • TOBIN* BRONZE
EVERDUR* • AVIALITE*
BERYLLIUM COPPER

Sheets, Wire
Rods, Tubes
Special Shapes

ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Conn.
In Washington, D. C.: 1511 K Street, N. W.
*Reg. U. S. Pat. Off.

AMERICAN CHAIN & CABLE
BRIDGEPORT • CONNECTICUT

★
ACCO PRODUCTS
•
FOR INDUSTRY TRANSPORTATION AGRICULTURE
★

ACCO
A·C·C
TRADE MARK

In Business for Your Safety

- **CHAIN** .. Weed Tire Chains • Welded and Weldless Chain and Attachments — AMERICAN CHAIN DIVISION
- **CABLE** .. Tru-Lay Preformed Wire Rope and Crescent Non-Preformed Wire Rope — AMERICAN CABLE DIVISION
- **AUTOMOTIVE & AIRCRAFT** .. Cable, Controls, Fittings • Tru-Stop Brakes for Trucks and Buses — AUTOMOTIVE AND AIRCRAFT DIVISION
- **CUTTING MACHINES** .. Wet Abrasive Cutting Machines • Nibbling Machines — ANDREW C. CAMPBELL DIVISION
- **CHAIN BLOCKS** .. and Trolleys — FORD CHAIN BLOCK DIVISION
- **WIRE ROPE** .. Lay-Set Preformed Wire Rope • Nonparell Non-Preformed Wire Rope — HAZARD WIRE ROPE DIVISION
- **PRESSURE GAGES** ... HELICOID GAGE DIVISION
- **AUTOMOTIVE EQUIPMENT** .. for garages and service stations — MANLEY MANUFACTURING DIVISION
- **WIRE** .. Welding Wire, Shaped Wire, Manufacturer's Wire, Chain Link Fence — PAGE STEEL AND WIRE DIVISION
- **LAWN MOWERS** .. Lawn Cleaners — PENNSYLVANIA LAWN MOWER DIVISION
- **VALVES** .. Bronze, Iron & Cast Steel — READING-PRATT & CADY DIVISION
- **AUTOMATIC REGULATING VALVES** — d'ESTE DIVISION
- **CASTINGS** — Steel • READING STEEL CASTING DIVISION; Malleable Iron • AMERICAN CHAIN DIVISION
- **HOISTS AND CRANES** .. Wright Chain Hoists, Electric Hoists, Cranes — WRIGHT MANUFACTURING DIVISION
- **BOLTS AND NUTS** .. Lag Screws and Forgings — THE MARYLAND BOLT AND NUT COMPANY
- **SPRINGS** .. Owen Springs and Units for Mattresses and Furniture — OWEN SILENT SPRING COMPANY, Inc.
- **HARDNESS TESTERS** .. ("Rockwell") — WILSON MECHANICAL INSTRUMENT CO., Inc.

In Canada .. **DOMINION CHAIN COMPANY,** *Limited*
In England .. **BRITISH WIRE PRODUCTS,** *Limited*
THE PARSONS CHAIN COMPANY, *Limited*

WIRE MAKER
to the
NATION

As the outstanding manufacturer of Wire and Wire Products, the American Steel & Wire Company has every facility and resource to serve you efficiently and to coöperate with you in connection with your requirements.

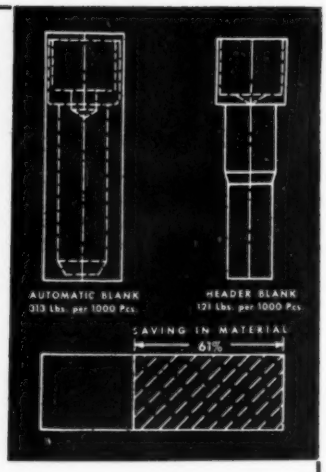
Wire Rope
Electrical Wires & Cables
Cold Rolled Strip Steel
Cold Finished Steel Bars
Springs
Manufacturing Wires
Welding Wire
Wire Fabric Reinforcement
Highway Guard Rail
Rail Bonds
Telephone & Telegraph Wire and Strand
Aërial Tramways
Wire Nails
Wire Hoops
Bale Ties
Wire Fencing
Steel Posts
Steel Gates
Barbed Wire
Tacks
U.S.S Stainless & Heat Resisting Cold Rolled Strip Steel, Wire & Wire Products
U.S.S High Tensile Steel Products

American Steel & Wire Company
Cleveland - Chicago - New York
Columbia Steel Company, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York, Export Distributors

USS UNITED STATES STEEL

COST CUT ½

By "NATIONAL" COLD HEADER METHOD



Here's a short "short story" with a profitable ending:

***Chapter 1*—Alert executive reads "Savings" booklet, briefly describing 15 typical jobs in which "National's" cold-heading methods cut costs, saved materials.**

***Chapter 2*—Smart as well as alert executive sends blueprints and samples of copper part to "National."**

***Chapter 3*—"National" engineering service and production facilities succeed in producing part at *one-half the former cost* . . . material saving, 61 per cent.**

Have you seen the booklet mentioned above? A request will bring a copy to you. Just ask for the "Savings" booklet.

THE NATIONAL SCREW & MFG. CO.
CLEVELAND 4, OHIO

Book Reviews

What the military reader can learn from the book is a first-hand view of the reactions of semitrained civilian soldiers in battle.—GEORGE S. BRADY.

RIFLEMAN'S PROGRESS. By Ellis Christian Lenz. Huntington: Standard Publications, Inc. 162 pp. $8.

THIS is a delightful little volume about a businessman who takes up military rifle shooting, goes through the Small Arms Firing School at Camp Perry, and proceeds to capitalize on the skill and experience thus acquired by bagging a series of prize heads on a subsequent African safari. To top everything off, he wins an N.R.A. members' rifle match on an Ohio range twelve years later.

Lenz, who has supplemented the photographic illustrations in this volume with sketches from his own pen, which means sketches of high merit, has managed to evolve a gripping yarn out of what could, at the hands of a less facile writer, have become a drab recitation of events. To him who has fired the military rifle in outdoor competition it will revive nostalgic memories; to the outdoorsman who has yet to enjoy this experience it extends an alluring invitation.—CALVIN GODDARD.

KEY TO JAPAN. Willard Price. New York: John Day Company. 309 pp. $3.50.

THIS is an eminently readable book by a man who has spent several years in Japan and has observed its people and customs with a trained journalistic eye. The title, however, seems rather ambitious for a text of some 300 pages, much of which consists of a sprightly discussion of what may be called the standard topics; the geisha, mixed bathing, bushido, excessive and insincere politeness, etc. A "key" which would really unlock Japan for an American would be truly a formidable treatise.

Considerable space is given to the more serious aspects which face our Government and its occupational forces. The book will amply repay reading by any one who is interested in getting a little better insight into that curious and, to an occidental, almost unknowable complex which is Japan. He will at least get a little appreciation of what makes a Japanese "tick."—R. H. SOMERS.

ARMS AND ARMAMENT. By Charles ffoulkes. London and Toronto: Geo. G. Harrap & Company, Ltd. 142 pp. $3.

THIS volume is a disappointment. It bears all the earmarks of undue rapidity of preparation, careless proofreading, and failure to consult a wealth of available source material. Factual errors are frequent—often flagrant.

Since this work is avowedly devoted to British arms and armament, it will probably have small appeal to the American arms fancier whose interests do not extend to the military matériel of the Mother Country. For those of more catholic tastes, however, the book contains much that will be novel to most American readers. To such, we commend it—with reservations.—CALVIN GODDARD.

BOOKS RECEIVED

DUTY TO LIVE. By Emmett Dedmon. Boston: Houghton Mifflin & Company. 271 pp. $2.50.

HARD POUNDING. By Lieut. Col. G. D. W. Court (British Army). Washington: *Field Artillery Journal*. 137 pp. $2.50.

TOP SECRET. By Ralph Ingersoll. New York: Harcourt, Brace & Company. 373 pp. $3.

BASIC INDUSTRIAL LOCATION FACTORS. Washington: U. S. Department of Commerce. 16 pp.

DEEP SIX. By Robert Carse. New York: William Morrow & Company. 311 pp. $2.50.

THE UNTERRIFIED. By Constance Robertson. New York: Henry Holt & Company. 503 pp. $3.